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REMARKS

Pursuant to 37 C.F.R. §1.111, reconsideration of the instant application, as amended herewith, is respectfully requested. Entry of the amendment is requested.

Claims 1-11, 13-50, 52-62, 64, 66-89, 91, 95-98 and 100-111 are presently pending before the Office. No claims have been canceled. Applicant has amended the specification and the claims. No new matter has been added. Support for the amendments can be found throughout the specification as originally filed. Applicant is not intending in any manner to narrow the scope of the originally filed claims.

The Examiner's Action mailed May 4, 2004 and the references cited therein have been carefully studied by Applicant and the undersigned counsel. The amendments appearing herein and these explanatory remarks are believed to be fully responsive to the Action. Accordingly, this important patent application is believed to be in condition for allowance.

First, Applicant thanks the Examiner for helping clarify what needs to be addressed during our telephone discussion of August 18, 2004. As indicated during the interview, Applicant herein submits a CD video, which shows equipment used to manufacture fuel according to the present invention, along with its actual use in test vehicles and a demonstration of the exhaust percentage of pollutants in the vehicle using the new inventive form of fuel. Further, the video has Applicant explaining analytically scientific and mathematical support for the present invention.

The Examiner is requested to view the video and to grant Applicant a telephonic interview where Applicant can direct the Examiner to specific documents already on file that overwhelmingly supports the magnecular clusters disclosed by Applicant. Further, Applicant will be able to answer any questions the Examiner may have. It is also clear that the Examiner has discussed this application with supervisors and to a major extent these supervisors have been influential in the on-going rejections in this application and in others. Applicant respectfully requests that any such supervisor, such as Vasu Jagannathan also be in attendance at the telephonic interview.

A request for such an interview is attached herein as well.

Applicant acknowledges the withdrawal of claims 102-111 with traverse.

The Examiner has rejected the claims under 35 U.S.C. §101, for the reasons discussed on page 3-4 of the Office Action. Further, The Examiner has also rejected the pending claims under 35 U.S.C. §112, first paragraph, by implicitly relying on the 101 rejection.

The Examiner alleges that the specification fails to provide an adequate written description of the invention and fails to adequately teach how to make and/or use the invention, i.e., fails to provide an enabling disclosure. In particular, the Examiner alleges that known principles of physics and chemistry show that the compositions claimed can not exist according to conventional theory. More specifically, no assertion of substantially pure population of the claimed clusters of magnecular characteristic have been recognized or verified by the scientific community.

First, it is interesting to note that the Examiner is referring to a section of the instant application where Applicant discusses Gibboney. Applicant is pointing out that if the new species was created with devices such as Gibboney, it effectively was not stable and self destructed so until Applicant found a way to produce and contain a stable pure population, the species was not detectable. Applicants specification clearly shows that the species is found. Applicant is not changing chemistry as we know it but showing that this new species is, for example, a cluster of molecules, under the effects of a magnetic field.

As pointed out in Applicant's last response in the form of Applicant's Rule 132 Declaration, there has been independent verification. Mr. Richardson in several of his patents has acknowledged seeing Applicant demonstrate the discovery. Mr. Leon Toups of Toups Technology has independently verified and actually advanced the commercialization of the new species. The Rule 132 Declaration executed on January 28, 2004 is herein incorporated by reference.

Mr. Louis A. Dee of the National Technical Systems Labs at McClelland Air Force Base has independently observed evidence of the new species. The evidentiary data obtained by the Labs is presented in the present application. This data is ignored by the Patent Office without any analysis of why the data in Figs. 7-25 should not be considered.

The new species also has great environmental characteristics. Evidence of Applicant's ability to make and contain a pure population is evidenced by the method and equipment and the principles by which such equipment can make the species, as described in the specification. Applicant has already received patents on some variations of the equipment and methodology described in the instant application. For example, a stable collected gas comprising a gas of the

new specie can be used to power cars as shown in the video provided herein to the Examiner. Test were run regarding the emissions of the test cars. On one of the cars being used without a catalytic converter, the emission detected O₂ emissions of 14.8%, CO₂ emissions of 4.2%, 0.05% CO and less than 1 ppm of HC, well below the EPA limits for vehicle fuels. This speaks volumes about the special nature of the new specie and is indicative that it is something different than what is known today in the chemistry and physics world.

More recently, tests were conducted on another car in California and the result was posted on a web site www.magnegas.com/technology/cleaning-fossil-fuels.htm wherein again the test car's emissions were significantly less without a catalytic converter, than other vehicles with catalytic converters using natural gas and gasoline. A copy of the web site report is attached herein.

The basic and fundamental issue is the admission of the vast EXPERIMENTAL evidence explicitly discussed in the instant application and intentionally ignored by the patent office on the NOVELTY of the new chemical specie of clusters having a magnecular characteristic, and characterized by peaks in the mass spectrometry and their LACK of IR signature for gases and LACK of UV signature for liquids. This feature prohibits the clusters to be molecules in themselves, thus establishing the novelty.

Magnecular clusters are predicted by conventional quantum electrodynamics, as treated in all technical details in Appendix 8A of Applicant's monograph "Foundations of Hadronic Chemistry", Kluwer Academic Publishers, provided to the patent office as a pre-publication version.

In fact, the basis of the magnecular clusters is the deformation of the orbitals of peripheral electrons from their space distribution to a toroidal distribution when exposed to an external magnetic field for which even its minimal value is predicted by the well established quantum electrodynamics.

As clearly stated in the patent application, individual toroidal polarizations are highly unstable because the spherical distribution is regained as soon as the external magnetic field is removed. However, when TWO or more toroidal polarizations are near each other, they attract each other via the opposing magnetic polarities created by said toroidal polarization forming a magnecular cluster. In this case rotations and other motions due to temperature occur for the MAGNETICALLY COUPLED atoms as a whole, resulting in stable clusters.

Regarding the statement by the examiner that “No assertions of substantially pure population of magnecules have been recognized or verified by the scientific community.”

This statement too is vacuous because it is directly contradicted by the publications included in the file. By its very definition, “scientific recognition” is achieved, certainly not because of statements released to newsmedia, but because of REVERED SCIENTIFIC PUBLICATIONS. Thus, for that purpose it is a significant scientific recognition that the aforementioned publication of the MONOGRAPH on magnecular cluster by one of the most revered scientific publishers in the world, Kluwer Academic Publishers, following about one year of in-depth reviews in their editorial offices in Boston, Dordrecht and London, has been achieved.

See in this respect a copy (attached herein) of the official reviews released by Kluwer with the names of their authors, reviews that were themselves published in revered scientific journals (Foundations of Physics and International Journal of Hydrogen Energy) in which

APPLICANT IS NOT an editor. How can anybody ask for more and then expect to keep his reputation in the scientific community?

The statement in the same page 4 to the effect that "The specification does not enable one of ordinary skill in the art to make or use substantially pure population of magnecules" is also vacuous. Various embodiments of the equipment used for the production of magnecular clusters is described in extreme details in several US patents already granted to Applicant and to Richardson who observed Applicant's development and testing results. The use of the magnecular cluster requires no other skill than filling up the tank of a car or using a stove to cook spaghetti.

Applicant herein again submits an article published by independent publisher PERMAGON PRESS in the International Journal of Hydrogen Energy 28 (2003) 177-196 summarizing the scientific acceptance of Applicant's findings.

Further, Applicant submits herein additional, some duplicative of what is contained in the instant application, reports and one article evidencing verification of Applicant's findings by independent labs. Absorption Research, Inc. Lab Reports, SpectraLab Report and Article published in Hydronic Journal 21, 789-894.

**APPLICANT HEREIN FURTHER SUBMITS INDEPENDENT REVIEWS FROM
MEMBERS OF THE SCIENTIFIC COMMUNITY REGARDING THE
AFOREMENTIONED KLUWER PUBLICATION OF APPLICANT'S MONOGRAPH.**

Reviews are presented by:

Professor Carl O. Trindle, Department of Chemistry, Univ. of Virginia;

Dr. Arthur Thomas, National Analytical Laboratories;

A.O. Animalu, University of Nigeria;

Prof. J. V. Kadeisvili, Institute for Basic Research;

Prof. A. K. Aringazin, Eurasian National University, Kazakhstan;

Prof. Jeremy Dunning Davies, University of Hull, England; and

Prof. Erik Trell, Linkoping University, Sweden.

The articles by the last two scientists are currently in press but are re-printed herein for the Examiner. (See attached independent reviews from scientific community).

These reviews clearly support Applicant's novel findings and are conclusive of the acceptance of Applicant's findings in the scientific community. Whether some scientists who do not understand quantum physics and the like, including quantum chemistry and mechanics, disagree with Applicant's findings is irrelevant. The reviews are favorable and encouraging and the rejection of the acceptance by the Examiner should be accompanied by technical reasons contraverting the findings, not summary dismissals based on not having an understanding of advanced chemistry and quantum physics.

In addition, the reviews clearly show that the scientific community does understand the scientific data supporting Applicant's finding, when presented with the evidentiary support and mathematical modeling of the invention.

As a practical matter, if any applicant had to wait for the scientific community to write articles in journals and magazines, then no application could be filed. Applicant has filed his applications and then published his findings, which is the only way to protect oneself.

Further, the experimental evidence and the reviews clearly support Applicant's invention and the Examiner should have the burden to refute the evidence and reviews by expressly directing her reasons for rejection to the evidentiary material in the patent application as well as in the reviews and data further submitted herein.

Regarding the sequence of 8 conditions overlapping into page 5 and following, Applicant submits that the Examiner is overlooking the existence of the detailed specifications in the instant application that describe embodiments of the equipment used to make the invention and reflected in Figs. 26 and 27. Specific details of the assembly of components and their operating parameters, including flow rates, temperature and pressures, are provided. In fact, Applicant has been granted patents, for which the Examiner is aware regarding other embodiments of apparatus and methods to produce the invention. One of these is US 6183604 referenced on page 50 of the specification. Pages 50-65 give detailed data on how to build and operate equipment to make the invention. Numerous recyclers producing the essentially pure population of magnecular clusters are now available in the USA, Europe and Kazakhstan.

Here are additional comments from page 5 on:

“(1) The breath of the claims”

The Examiner is merely stating that if the 101 rejection applies, then implicitly, the 112, first paragraph rejection applies, again a rejection based without any scientific refutation of the facts. The new chemical species discovered by Applicant is a great advancement to the age of reduction of reliance to fossil fuels. As Prof. Aringazin states:

Santilli also provides simple means for the construction of hadronic mechanics and chemistry at all levels, which means are given by nonunitary transforms of all aspects of conventional theories. Such a nonunitary character also ensures that hadronic mechanics and chemistry are outside the class of equivalence of conventional theories. Intriguingly, hadronic mechanics and chemistry result in an explicit and concrete realization of the theory of hidden variables, as well as a completion of quantum mechanics and chemistry much along the lines of the celebrated argument by Einstein, Podolsky and Rosen of 1935. Also intriguingly, isotopic operator theories admit a generalization of Bell's inequality which possess a classical counterpart, with consequential profound revisions of local realism....

“(2) The nature of the invention.”

The Examiner's comment is incredulous because her belief that the scientific community thinks magnecular clusters do not exist. It is unwise to file a patent application after it is in the public domain, especially such a novel scientific finding. The very filing of this instant application is evidence that the new species is vastly UNKNOWN to the scientific community. How can one possibly obtain first the recognition by the scientific community, that require vast publications in magazines, etc., and then file a patent application?

“(3) The state of the prior art.”

The reason there is no prior art because Applicant was the first to discover the new species.

“(4) The level of one of ordinary skill.”

The Examiner is stating without specificity that the most highly skilled physicists and chemist agree that the invention cannot be produced. No mention of any specific scientist is mentioned. Applicant has a right to address any adverse comments made by other scientist.

Applicant points out that a general denial by a scientist who has not attempted to evaluate and repeat the invention should not be used by the Examiner. A reputable scientist will first try to repeat the invention and show data as to why the invention is not achievable. But a general statement disagreeing in principle only is irresponsible. Again, the gas produced using equipment described in the present application was used to fuel the test cars in the video sent herein to the Examiner and in the California test car described on the above mentioned web site. The Examiner should be refuting the evidence of the emissions predicted by the present invention because of the magnecular structure of the invention.

“(5) The level of predictability in the art.”

ALL PlasmaArcFlow™ Recyclers produce a gas with an essentially pure population of magnecular clusters, always so, without exception. How can experimental evidence be more predictable than that?

“(6) The amount of direction provided by the inventor.”

The Equipment and Process Steps are specified in detail on pages 50-65 of the specification, as well as in US 6183604, in US 6673322, in US 6540966 and in US 6663752, all patents to Applicant for equipment and methods related to other embodiments to make gas according to the present invention.

In the subsequent statement at the top of page 7, the Examiner states: "It is the examiner's opinion that applicant has not provided sufficient guidance throughout the specification to enable one of ordinary skill in the art to make and use the instant invention." This is incredible given the details at pages 50-65, Figs. 26 and 27, and in view of the above mentioned four patents!

The creation of an essentially pure population of magnecular clusters merely requires flowing a liquid through an electric arc at specified temperatures and pressures, and then collecting the produced gas that bubbles to the surface of the liquid. What can be simpler than that? What type of special skills are required?

The use of the produced gas with magnecular structure is exactly the same as the use of ANY OTHER COMBUSTIBLE GAS, such as natural gas, etc.

"(7) The existence of working examples."

The video clearly shows working examples of equipment (referred to by Applicant as reactors or recyclers in the video) used to make the present invention. Further, there are several in several countries.

(8) The quantity of experimentation needed to make or use the invention."

Absolute NONE is needed, again, because various recyclers are available NOW and, to repeat the invention. The use of gas comprising the present invention is identical to that of any other gaseous fuels as shown by the use in test cars shown in the accompanying video.

A serious technical question is raised by the examiner in page 9 when asking "Are all unidentifiable peaks in a mass spec magnecules?" The scientific answer is NOT NECESSARILY because these peaks could be molecules not yet identified until now. As clearly stated in the patent application, **only the additional experimental evidence on the LACK of IR signature for gases and UV signature for liquids establishes that unidentified peaks in the mass spec are magnecular clusters.** This is why the claims limit the invention to these specific circumstances.

Applicant is not persuaded that those skilled in the art cannot define or determine the metes and bounds of Applicant's invention.

It is noted that the Examiner has cited no authority upon which to base a position for limiting the scope of the claimed invention, other than general non-specific allegations that scientists have not accepted Applicant's invention, without showing any refuting evidence by those scientist.

If some scientists were to propose that there no support for the "Black Hole" theory without providing any evidence to contradict those who propounded the theory, then the Black Hole theory would not be accepted today. Even the Cold Fusion issues raised a few years ago were first raised into question by scientists who tried to repeat and model the theory. In this case,

no scientist to date who has not agreed with Applicant has ever attempted to build a reactor and to disprove Applicant. Asking Applicant for a sample of gas produced by Applicant could have been sent to independent labs by these scientists and not a single one did. Therefore, their general disagreement with Applicant should be given no weight, without more in the form of independent analysis and testing.

Satisfaction of the enablement requirement, of course, is a question of law. To provide answers to this question, the disclosure is analyzed on a "how to make" criteria and on a "how to use" criteria.

Applicant has clearly set forth a concise disclosure on how to make the invention, as described above. Applicant also has clearly demonstrated how to use the invention. No authority has been cited to indicate that any of the specific claimed embodiments could not be made or could not be used as taught by Applicant, other than general, non-specific denials by non-named scientists in the scientific community. In short, there is no reasonable basis for doubting that Applicant's claimed invention could be made and/or used, especially in light of the accompanying video.

In particular, those skilled in the art would not find the invention as claimed to be unduly broad in the context of the Specification. Claims certainly would not be read to cover inoperative embodiments.

As mentioned above, Applicant respectfully submits that the broad scope is supported by the specification. The claims provide a clear warning to others as to what will constitute infringement. The standard of review is the rule of reason.

The Office has provided no technical reasons why the invention within the broad scope of the claims would not be operative. The Examiner's opinion that the disclosure does not appear

to enable the scope of the protection sought by the claims is not the standard. In re Driscoll, 562 F.2d 1245, 195 U.S.P.Q. 434 (C.C.P.A. 1977).

Applicant intended to cover the broad scope of the invention set forth in the Specification. The best mode to make and use the invention is similarly described in the Specification on pages 50-65 and Figs, 26 and 27 thereof. Those skilled in the art are clearly taught how to make and use the invention.

The Federal Circuit stated the standard for determining compliance with the written description requirement as follows:

Although the applicant does not have to describe exactly the subject matter claimed, the description must clearly allow persons of ordinary skill in the art to recognize that he or she invented what is claimed. The test for sufficiently of support . . . is whether the disclosure of the application reasonably conveys to the artisan that the inventor had possession at that time of the later claimed subject matter.

Vas-Cath, Inc., v., Mahurkar, 935 F.2d 1595, 19 U.S.P.Q.2d 1111 (Fed. Cir. 1991). For purposes of this inquiry, the invention is whatever is claimed.

Further, it should be noted that the enablement requirement under Section 112 may also be satisfied even if a person of ordinary skill in the art must conduct a certain, limited degree of experimentation in order to reproduce the invention. This principle is uniformly recognized by all courts dealing with patent matters. Applicant however submits that absolutely no experimentation is required as a mechanic and metals fabricator could assemble the equipment and anyone who can read how to turn on power and operate valves, while reading temperature, pressure and power gauges can operate the equipment to make the invention.

By way of emphasis, the courts have also consistently held that the disclosure of invention set forth by an Applicant must be given a presumption of correctness and operativeness

by the Office and that the only relevant concern of the Office should concern the truth of the assertions contained in the disclosure. The court in In re Marzocchi, 439 F.2d 220, 169 U.S.P.Q. 367 (C.C.P.A. 1967) states this principle with clarity:

As a matter of Patent Office practice, then, a specification disclosure which contains a teaching of the manner and process of making and using the invention in terms which correspond in scope to those used in describing and defining the subject matter sought to be patented **must** be taken as in compliance with the enabling requirement of the first paragraph of §112 **unless** there is a reason to doubt the objective truth of the statement contained therein which must be relied on for enabling support . . . In any event, it is incumbent upon the Patent Office, whenever a rejection on this basis is made, to explain **why** it doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement. Otherwise, there would be no need for the applicant to go to the trouble and expense of supporting his presumptively accurate disclosure.

Applicant respectfully submits that the language and format of the amended claims clarify the issues raised in the Examiner's Action. Accordingly, in view of the present amendments and arguments, Applicant respectfully requests that the Examiner withdraw the rejection of the claims under 35 USC 101 and 35 U.S.C. §112, first paragraph.

CONCLUSION

Even though the initial claims in this important patent application were drawn to a new, useful and nonobvious invention, they have now been amended to increase their specificity of language. Applicant respectfully submits that the pending claims are patentable over the art of record.

A Notice of Allowance is earnestly solicited.

If the Office is not fully persuaded as to the merits of Applicant's position, or if an Examiner's Amendment would place the pending claims in condition for allowance, a telephone call to the undersigned at (727) 538-3800 would be appreciated.

Very respectfully,

Dated: 10/19/04



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Recycling Liquid Wastes and Crude Oil into MagneGas™ and MagneHydrogen™

Santilli's New Clean Fuels With Magnecular Structure

[For a generic description click here, for scientific works click here,
and for a PowerPoint® presentation click here]

MagneGas™ and MagneHydrogen™ are brand names of new fuels whose Trademarks are owned by Hadronic Press, Inc., 35246 US 19 No. # 215, Palm Harbor, FL 34684, U.S.A.

[HOME](#) ::: [TECHNOLOGY](#) ::: [PATENT INFO](#) ::: [PART 1](#) ::: [PART 2](#) ::: [PART 3](#) ::: [PART 4](#) ::: [PART 5](#)

CLEANING FOSSIL FUELS EXHAUST WITH MAGNEGAS™ ADDITIVE

(Patented and International Patents Pending)
September 28, 2004

MagneGas™ fuel was certified by an EPA accredited laboratory for use as automotive fuel without catalytic converters while surpassing all current EPA requirements (for details, visit the web page <http://www.magnegas.com/technology/part7.htm>).

A summary of the measurements is provided in the table below.

Element	MagneGas (MG)	Natural Gas	Gasoline	EPA Standards
Hydro-carbons	0.026 gm/mi	0.380 gm/mi 2460% of MG emission	0.234 gm/mi 900% of MG emission	0.41 gm/mi
Carbon Monoxide	0.262 gm/mi	5.494 gm/mi 2096% of MG emission	1.965 gm/mi 750% of MG emission	3.40 gm/mi
Nitrogen Oxides	0.281 gm/mi	.732 gm/mi 260% of MG emission	0.247 gm/mi 80% of MG emission	1.00 gm/mi
Carbon Dioxide	235 gm/mi	646.503 gm/mi 275% of MG emission	458.655 gm/mi 195% of MG emission	No EPA standard exists for Carbon Dioxide
Oxygen	9%-12%	0.5%-0.7% 0.04% of MG emission	0.5%-0.7% 0.04% of MG emission	No EPA standard exists for Oxygen

The data were obtained via the use of a Honda Civic dedicated to natural gas and used for magnegas without any change, thus without the optimization for magnegas of timing and stoichiometric ratio that were intentionally not done to show that a natural gas car can also run on magnegas without costly changes while improving the exhaust. The data on gasoline were obtained via the use of an identical Honda Civic dedicated to gasoline use. All data were obtained via the use of the complex EPA routine simulating various city and mountain driving.

Note the dramatic quality of magnegas exhaust as compared to the exhaust of natural gas and gasoline. In fact,

magnegas exhaust contains about 1/15-th of the EPA requirements; has about 50% less green gases (CO₂) than gasoline exhaust; and contains 9% to 12% breathable oxygen. Therefore, **magnegas™ is the only known fuel whose exhaust can sustain life** (hydrogen exhaust cannot sustain life because of the lack of oxygen). Note finally that the data on magnegas can be improved via the proper optimization of timing and stoichiometric ratio.

As a result of these measurements, it was indicated in various parts of this web site (see, for instance, <http://www.magnegas.com/technology/part5.htm>) that **magnegas fuel can be used as an additive to fossil fuels for the improvement of their exhaust.**

In first approximation it is now possible to pre-select the desired improvement of fossil fuels exhaust and then compute the needed percentage of magnegas as additive from the above table. Actual data show that the magnegas percentage is generally smaller than that predicted in this way for various technical reason connected to the novel magnecular structure of magnegas.

The above possibilities have been recently confirmed with systematic tests conducted on mixtures of Natural Gas (NG) and MagneGas (MG) as additive in electric generators, cars and other uses. Here is a representative example.

The combustion exhaust of a 4 cylinder Ford Contour 2000 regularly sold in California to run on NG with the legally required catalytic converter was first analyzed via a 4-ways analyzer produced and certified by U. Planet Equipment Corporation in the U.S.A., resulting in the following data:

Exhaust for 100% Natural Gas

HC 33 ppm; CO 0.00%; CO₂ 10.42%; O₂ 1.06%; NOx 20 ppm.

Subsequently, the same car was tested without any modification to the computer or the exhaust system (thus, again, without any optimization for magnegas of timing and stoichiometric ratio) with a mixture of approximately 2/3 NG and 1/3 MG (more precisely, the tank at 2,000 psi of NG was brought to 3,000 psi with MG via the use of a compressor manufactured by Aerotecnica Coltri in Italy, model MCH13-16/ET OPEN). Magnegas was produced by recycling antifreeze waste, thus having smaller thermal and hydrogen content as compared to magnegas produced from oil. The use of the same Planet 4-ways analyzer yielded the following data:

Exhaust for 2/3 Natural Gas and 1/3 MagneGas

HC 0 ppm; CO 0.00%; CO₂ 11.42%; O₂ 1.30%; NOx 0 ppm.



A View of the Ford Contour 2000 used for the tests.

The above tests and related measurements confirm the preceding statements in this web site because:

- 1) The use of magnegas as 1/3 additive completely eliminates the HC in the exhaust to such an extent that the analyzer at times measures negative values (meaning that the exhaust has *less* HC than the environment). As stated elsewhere in this web site, this result is due to the high percentage of hydrogen in magnegas (about 50% in the magnegas used in the tests). Since hydrogen has the biggest flame temperature and speed among all known fuels, the combustion of the hydrogen content of magnegas as an additive to fossil fuels burns all uncombusted HC without need of a catalytic converter as per the indicated certification.
- 2) The power of the Ford Contour 2000 with the 2/3 NG 1/3 MG mixture was clearly increased over the pure NG fuel by at least 10%. This is a necessary consequence of the combustion of the unburned HC in the engine (rather than in the catalytic converter). Alternatively, any reduction of HC emission implies a necessary increase of power under the same consumption, trivially, because HCs are unburned parts of fossil fuels. Equivalently, the reduction of HC in the exhaust permits the achievement of the same power with a proportionately smaller consumption of fossil fuels.
- 3) The running temperature was decreased by about 20% as proved by the elimination of the NOx in the exhaust. In fact, the presence of hydrogen in magnegas as additive produces water vapors in the exhaust with a consequential lowering of the exhaust temperature, while NOx's are proportional to the engine temperature (the reduction of exhaust temperature in the use of pure magnegas is about a 30% reduction as compared to NG exhaust temperature and about a 50% reduction as compared to gasoline exhaust temperature). . 4) The small increase of CO2 is due to secondary chemical reactions caused by the catalytic converter, that is no longer necessary when using magnegas as additive while meeting or surpassing EPA requirements. As established by numerous chemical analyses, magnegas contains no HC and burns the uncombusted HC, thus eliminating the need for the catalytic converter.
- 5) The marginal increase of oxygen in the exhaust is also due to the use of the catalytic converter that depletes the high oxygen content of magnegas as shown by the Table above.

Needless to say, similar results can be obtained via the use of MG in *smaller percentage* than 1/3 due to the null values of HC and NOx, while better results with decreased CO2 and increased O2 can be obtained by eliminating the catalytic converter and/or via the use of *bigger percentages* of magnegas as additive.

Essentially the same results can be expected via the use of gasoline and catalytically liquefied magnegas as additive. Note that magnegas IS NOT recommended as an additive to diesel due to the increase of CO in the exhaust caused by the extremely high compression in the diesel combustion (magnegas cannot be ignited under these extreme compressions, thus experiencing chemical mutations that are absent for normal storage pressures up to 5,000 psi or 330 bars). The ideal diesel additive is MagneHydrogen (namely, the hydrogen separated from magnegas via molecular sieving or other processes) because cost competitive with respect to fossil fuels while enjoying the new magneclar bond with diesel that is absent for ordinary hydrogen.

Technical presentations can be obtained in the papers available in pdf format (contact info@magnefuels.com for the publication data in refereed journals)

STRUCTURE AND COMBUSTION OF MAGNEGASES

R. M. Santilli and A. K. Aringazin

physics/0112066

33 pages, 2 figures.

A STUDY OF THE ENERGY EFFICIENCY OF HADRONIC REACTORS OF MOLECULAR TYPE

A. K. Aringazin and R. M. Santilli

physics/0112067

25 pages, 2 figures.

A STUDY OF POLYCARBONYL COMPOUNDS IN MAGNEGASES

A. K. Aringazin and R. M. Santilli

physics/0112068

17 pages, 8 figures.

**TOROIDAL CONFIGURATION OF THE ORBIT OF THE ELECTRON OF THE HYDROGEN ATOM
UNDER STRONG EXTERNAL MAGNETIC FIELDS**

A.K. Aringazin,
to appear in Hadronic J. (2001), 39 pages.
PDF-file, 670 Kb.

**ISOELECTRONIUM CORRELATIONS AS A NONLINEAR TWO-DIMENSIONAL TWO-PARTICLE
TUNNEL EFFECT**

A.K. Aringazin and M.B. Semenov,
19 pages, August 2000, to be published.

**ON VARIATIONAL SOLUTION OF THE FOUR-BODY SANTILLI-SHILLADY MODEL OF H₂
MOLECULE**

A.K. Aringazin,
Hadronic J. 23 (2000) 57-113. physics/0001057.

**EXACT SOLUTION OF THE RESTRICTED THREE-BODY SANTILLI-SHILLADY MODEL OF THE
H₂ MOLECULE**

A.K. Aringazin and M.G. Kucherenko,
Hadronic J. 23 (2000) 1-56. physics/0001056.

**ESTIMATE OF THE POLARIZED ORBITAL MAGNETIC MOMENT OF THE ISOELECTRONIUM IN
THE HYDROGEN MODULE**

M.G. Kucherenko and A.K. Aringazin,
Hadronic J. 21 (1998) 895-902.

Additional information can be obtained by contacting info@magnefuels.com

. The above measurements can be repeated for any qualified observer paying all their costs.

HOME :: TECHNOLOGY :: PATENT INFO :: PART 1 :: PART 2 :: PART 3 :: PART 4 :: PART 5

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International Journal of Hydrogen Energy 28 (2003) 177–196

International Journal of
**HYDROGEN
ENERGY**

www.elsevier.com/locate/ijhydene

The novel magnecular species of hydrogen and oxygen with increased specific weight and energy content

Ruggero Maria Santilli *

*Institute for Basic Research, P.O. Box 1577, Palm Harbor, FL 34682, USA**Dedicated to Amedeo Avogadro (1776–1856)*

Abstract

In this paper we review the new chemical species of *magnecules* introduced in preceding works (see monograph, R.M. Santilli, Foundations of hadronic chemistry with applications to new clean energies and fuels. Boston-Dordrecht-London: Kluwer Academic Publisher, 2001 for a general review), which consist of individual atoms, radicals and ordinary molecules bonded together into stable clusters under a new internal attractive force originating from the toroidal polarization of the orbitals of atomic electrons under strong external magnetic fields. We then introduce, apparently for the first time, the hypothesis of new chemical species of hydrogen, oxygen and other gases with magnecular structure called *MagneHydrogen™*, *MagneOxygen™*, etc. or *MagneH™*, *MagneO™*, etc. for short (international patents pending). We then present the experimental evidence according to which the latter gases possess specific weight and energy content greater than the corresponding values of the same gases with conventional molecular structure. We show that the use of MagneH and MagneO in fuel cells implies: (1) an increase of fuel cells voltage, power and efficiency; (2) a decrease of storage volumes; and (3) a significant decrease in operating costs. The equipment for the industrial production of MagneH and MagneO is identified. We also study a particular form of MagneH with specific weight of about 7 times that of the hydrogen which is particularly suited for use as fuel in internal combustion engines, and show that such a new species implies: (i) the elimination of liquefaction of conventional hydrogen as currently used by BMW, GM, and other car manufacturers; (ii) performance essentially equivalent to that of the same engine when operating on gasoline; and (iii) the achievement of cost competitiveness of MagneH with respect to fossil fuels, of course, when produced in sufficiently large volumes. We also indicate that the liquefaction of MagneH and MagneO is predicted to cost significantly less than ordinary gases (in view of a mutual attraction among magnetically polarized magnecules which does not exist in conventional gases), and that their use as fuel for rocket propulsion is expected to imply a significant increase of the payload, or a corresponding decrease of boosters weight. All the above advances are dependent on the features of the selected equipment for the production of MagneH and MagneO (including electric power, pressure, etc.), as well as the duration of the processing. The paper ends with the indication of other applications of the new chemical species, the solicitation of independent experimental verifications, and the identification of new intriguing open problems.

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Keywords: Magnecules; Magnehydrogen; Hadronic chemistry

1. Introduction

Hydrogen is emerging as one of the primary alternative fuels for the large scale replacement of gasoline and other fossil fuels, including its use for internal combustion engines, fuel cells, rocket propulsion and other applications.

However, hydrogen is a fuel with the lowest specific weight among all available fuels. In fact, hydrogen has a specific weight of 2.016 atomic mass units (a.m.u.). By comparison, gaseous hydrocarbons can have specific weight which are a multiple of these values, as in the case of natural gas, methane, acetylene and other gaseous fuels.

This low value of specific weight and the current high cost for its production, have caused serious technological, logistic and financial problems which have prevented hydrogen from achieving a large scale replacements of fossil fuels until now.

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Among the existing problems, we mention the following ones:

- (1) The low specific density of hydrogen prevents its automotive use in a compressed form because of the need for excessively large storage requirements, as well as seepage through containers walls. For instance, gasoline contains about 115,000 British Thermal Units (BTU) per American gallon (g) while hydrogen has an energy content of about 300 BTU per standard cubic foot (scf). As a result, the *gasoline gallon equivalent of hydrogen* is given by $115,000 \text{ BTU}/300 \text{ BTU} = 383 \text{ scf}$. Therefore, the equivalent of a 20 g gasoline tank would require 7660 scf of hydrogen which is a prohibitive volume for storage in an ordinary car.
- (2) As proved by hydrogen fueled automobiles built by the German automakers BMW, the American automaker GM, and other car manufacturers, the achievement of a sufficient range for ordinary automotive use requires the *liquefaction of hydrogen*. By recalling that hydrogen liquifies at a temperature of -252.8°C close to absolute zero degree, it is evident that the liquefaction of hydrogen, its transportation in a liquified form and the permanent storage of such a liquid state in a car implies dramatic expenditures. It then follows that the current automotive use of hydrogen is excessively more expensive than gasoline.
- (3) The automotive use of hydrogen implies a loss of about 35% of the power of the same engine when operated with gasoline, as established by available hydrogen powered cars. This is evidently due to the low energy content of hydrogen, with consequential combustion of more moles to reach the same performance as that with gasoline.
- (4) In view of the above, the automotive use of hydrogen produced from regenerating methods implies an *oxygen depletion* greater than that caused by the combustion of fossil fuels for the same power and performance, where “oxygen depletion” has been introduced by this author to characterize the *permanent removal of breathable oxygen from our atmosphere* [1]. This oxygen depletion persists when hydrogen is produced via electrolytic separation of water and the use of electricity from fossil fuel powered plants. Said oxygen depletion is absent only when hydrogen is produced via the electrolytic separation of water and the use of electricity produced via solar, hydro and other methods not requiring atmospheric oxygen.
- (5) The automotive use of liquid hydrogen is dangerous because of the possible transition of state from liquid to gas in the event of a malfunction of the cryogenic equipment or other reasons.

The use of hydrogen in fuel cells is afflicted by similar problems which are inherent in the low specific weight of conventional hydrogen.

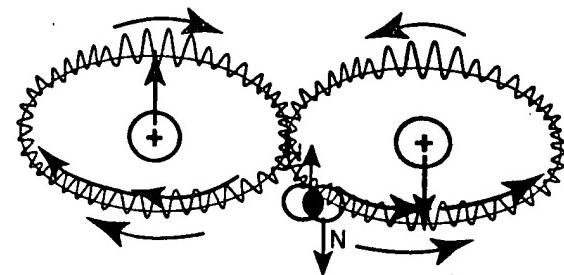


Fig. 1. A schematic view of the *isochemical model of the hydrogen molecule*, here represented at absolute zero degree temperature without any rotation, which was introduced by Santilli and Shillady in Ref. [2] (see [5] for a comprehensive review). The main assumption is that, when at short distances of the order of the size of their wavepackets ($10^{-13} \text{ cm} = 1 \text{ fm}$) and in singlet coupling, electrons experience a new strongly attractive valence force resulting in a quasi-particle state called *isoelectronium*. The most stable orbit then results to be oo-shaped with each o-branch distributed around each nucleus, thus having opposing rotations, a feature of fundamental character for the new chemical species of hydrogen introduced in this paper. Needless to say, the deep correlation-bond of two valence electrons into the isoelectronium is not a permanent bound state, but has a finite meanlife depending on the considered molecule, its excitation state, and other factors studied in Ref. [5].

In this paper we introduce, apparently for the first time, a new chemical species of hydrogen as well as oxygen and other gases which alleviates, if not resolves the above problems due to their increased specific weight and energy content.

The studies underlying the proposed new chemical species can be summarized as follows. In Refs. [2,3] (see also the comprehensive review in monograph [5]) R.M. Santilli and D.D. Shillady introduced the *isochemical model of the hydrogen, water and other molecules* (Figs. 1 and 2) which permitted the achievement, apparently for the first time in chemistry, of a numerical representation of binding energies, electric and magnetic moments, as well as other molecular features exact to the desired digit. The new models also achieve the first restriction of valence correlations to *electron pairs*, as established experimentally, exhibits perturbative series converging dramatically faster than those of quantum chemistry (with consequential major reduction of computer time), and resolve other vexing problems of current molecular chemistry (see [5] for details).

These results were achieved by assuming that two valence electrons couple themselves into a singlet state at short distances, called *isoelectronium*, with a new, strongly attractive force due to the deep overlapping of the electron wavepackets. The new *strong valence force* results to be nonlinear (in the wavefunctions), nonlocal (e.g., of integral type) and nonpotential (e.g. of contact zero-range type). Also, the new force can be thought as the previously missing molecular equivalent of the nuclear strong interactions (the evident understanding is that the use of the word “strong” referring

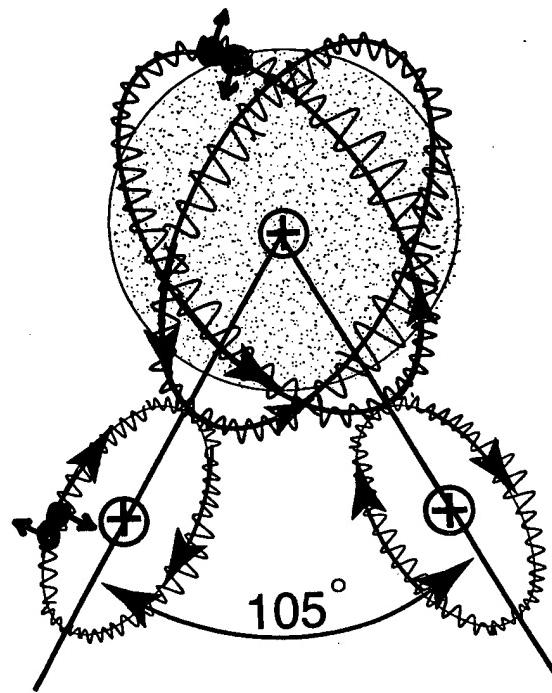


Fig. 2. A schematic view of the *isochemical model of the water molecule*, here represented at absolute zero degrees temperature without any rotation, which was submitted by Santilli and Shillady in Ref. [3] (see monograph [5] for a comprehensive review and enlargement). The main assumption is that the bond in each radical HO and OH is characterized by a new *strong valence force* originating in the deep correlation of valence electron pairs in singlet coupling at short distances, called *isoelectronium*. Note that the distribution of the electron orbits in each radical HO and OH is perpendicular to the molecular plane HOH, as experimentally established, a feature also of fundamental relevance for this paper.

to electrons has no connection with the “strong interactions” in hadron physics). The strong nature of the new valence force then permits an essentially exact representation of binding energies and other molecular features. By comparison, the exact use of quantum axioms still misses 2% of binding energies, with much greater departures from experimental data (at times even in the sign) regarding electric and magnetic moments, and other molecular features.

Being nonlinear, nonlocal and nonpotential, the new strong valence force cannot be represented with the Hamiltonian alone, thus requiring at least one second operator. As such, the new strong valence force is outside any dream of scientific treatment via conventional quantum mechanics and chemistry, since the latter are strictly linear, local and potential (i.e., the systems are entirely described by a linear, local, and differential Hamiltonian). In view of these limitations, new mathematical, physical and chemical theories had to be worked out for the invariant treatment of the new strong valence force. These new formulations are known under the name of *hadronic mechanics, superconductivity*

and chemistry and are reviewed in detail in monograph [5].

Hadronic chemistry is based on the lifting of the basic unit, from its simple value $I=+1$ currently used in chemistry (and dating back to biblical times) to the most general possible integro-differential operator of hermitian or nonhermitian, single-valued or multi-valued character, with corresponding lifting of all possible conventional associative products $A \times B$ among generic quantities A, B (such as numbers, functions, operators, etc.)

$$I = +1 \rightarrow \hat{I} = \hat{I}(t, r, p, \psi, \partial_k \psi, \dots) = 1/\hat{T},$$

$$A \times B \rightarrow A \hat{\times} B = A \times \hat{T} \times B,$$

$$I \times A = A \times I = A \rightarrow \hat{I} \hat{\times} A = A \hat{\times} \hat{I} = A \quad (1.1)$$

with corresponding liftings of the entire mathematical and physical structure of conventional theories. All conventional linear, local and potential effects are represented with the usual Hamiltonian, while all nonlinear, nonlocal and nonpotential effects are represented with the generalized unit \hat{I} . Consequently, hadronic chemistry has various branches, called *iso-, geno- and hyper-chemistry* which are characterized, correspondingly, by *single-valued hermitian, single-valued-nonhermitian, and multi-valued-nonhermitian generalized units*. These branches are used for the invariant treatment, respectively, of *closed-isolated systems with nonhamiltonian internal effects, open-irreversible systems, and irreversible multi-valued biological structures* (see Ref. [5] for a general review of hadronic chemistry and its main background references).

This paper deals with molecular structures considered as isolated from the rest of the universe. As a result, the applicable branch of hadronic chemistry is *isochemistry*. The background structure model of the hydrogen and water molecule are, therefore, those of Figs. 1 and 2. The new chemical species of hydrogen, oxygen and other gases presented in this paper are another development permitted by the novel isochemistry.

Note, in particular, that a strong correlation-bond of valence electron pairs into the isoelectronium implies that the molecular orbit is o-shaped with each o-branch distributed around each nucleus (Fig. 1). A property of fundamental character for the new chemical species of hydrogen and oxygen, is that *the directions of rotation of coupled valence pairs around the respective two nuclei are opposite to each other*. This feature is mandatory for a scientifically credible structure model of the hydrogen because the assumption of orbits encompassing the two nuclei, in addition to serious instabilities, would imply the possibility of a magnetic polarization of the hydrogen, as discussed in more detail later on, which prediction is dramatically disproved by experimental evidence since the hydrogen is diamagnetic. By comparison, such a diamagnetic character is easily recovered for the isochemical structure of Fig. 1 because a

magnetic polarization would yield *opposing* magnetic polarities in the two atoms which cancel out when inspected at large distance due to the very small inter-atomic distances.

The reader should also note that our study is based on semiclassical *orbits* because of their conceptual effectiveness particularly during the intuitional phase, with the understanding that a more rigorous treatment is that in terms of *orbitals* as conventionally understood in chemistry (probability distributions). The use of semiclassical *orbits* is also preferred to indicate that the new species of hydrogen, oxygen and other gases presented in this paper have a purely *physical*, rather than chemical, origin. Needless to say, all notions introduced in this papers in terms of orbits have a simple extension to the corresponding notions in terms of orbitals, which extension is left to the interested reader for brevity.

Note finally that the presentation of this paper has been limited to that at a semiclassical level for clarity of the basic notions and results. The reformulation in terms of the new isomathematics for first and second quantization yields no new results and it is left to the interested reader.

2. The new chemical species of Santilli magnecules

A scientific notion of basic importance for this paper is the new chemical species of *electromagnecules* which was first submitted by this author in paper [4] of 1998 and then presented in a comprehensive form in the recent monograph [5].

Electromagnecules are clusters generally composed of individual atoms, parts of conventional molecules (called radicals or dimers) and ordinary molecules under a new internal bond originating from the electric and magnetic polarizations of the orbits of at least some peripheral atomic electrons. Due to the dominance of magnetic over electric polarizations indicated below, electromagnecules are generally called *Santilli magnecules*.

The basic notion underlying magnecules is a property well known in atomic physics (see, e.g., Ref. [6]), according to which, when an atom is exposed to a sufficiently strong external magnetic field, the orbits of its peripheral electrons cannot be freely distributed in all space directions, and must acquire a *toroidal distribution* with consequential creation of a new magnetic dipole moment North–South caused by the rotation of the electron charges in said toroid. Such a dipole is evidently aligned along the symmetry axes of the toroidal distribution in such a way to have magnetic polarities opposite to the external ones, as illustrated in Fig. 3.

It should be noted that the magnetic polarization of an atom also implies the polarization of the intrinsic magnetic moments of electrons and of nuclei, as illustrated in Fig. 1. As a result, the magnetic bond between polarized atoms is actually composed of *three parallel attractive forces* among opposite polarities.

Atoms, radicals or molecules with toroidal polarization of their atomic orbits then bond to each other in chains of

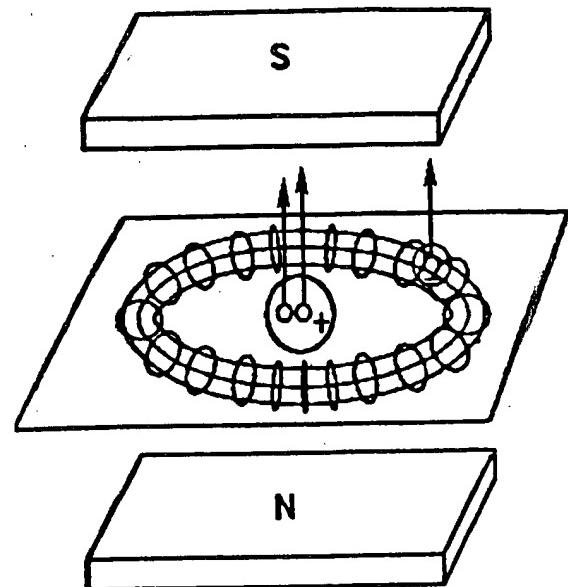


Fig. 3. A schematic view of the *toroidal polarization of the orbits of peripheral atomic electrons when subjected to a sufficiently strong external magnetic field*. Note the additional polarization of the intrinsic magnetic moments of nuclei and of peripheral atomic electrons, thus resulting in the availability of *three parallel magnetic moments* all suitable to create a new bond.

opposing polarities North–South–North–South–..., resulting in the formation of magnecules schematically illustrated in Fig. 4.

Note that the toroidal polarization of atomic orbits creates a magnetic field which is not generally detectable in the conventional space distribution of the same orbits. Simple calculations show that such a field is quite strong since it is of the order of 1415 times the value of the intrinsic magnetic field of the nucleus of hydrogen (the proton). As a result, the toroidal polarization of the orbits of peripheral atomic electrons does indeed create a new field sufficiently strong to originate a new chemical species.

The first computation of the value of the magnetic moment of toroidal polarizations of atomic orbits and its use for the creation of a new chemical species was apparently presented for the first time by the author in Ref. [4]. The first verification of its numerical value as being 1415 times the value of the proton magnetic moment was done by Kucherenko and Aringazin [7]. An in depth study of the toroidal polarization of atomic orbits was done by Aringazin [8] and reviewed in Appendix 8A of monograph [3].

Predictably, these studies have established that the toroidal polarization of atomic orbits requires magnetic fields so strong that they cannot be today realized at macroscopic distances in our laboratories. Nevertheless, these strong magnetic fields are indeed available at *atomic distances*, as we shall see.

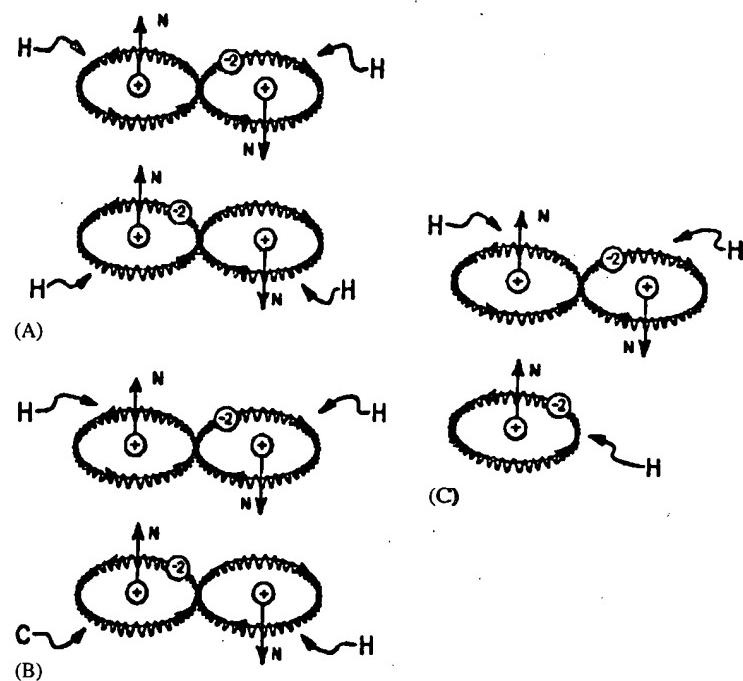


Fig. 4. A schematic view of *elementary magnecules* composed of a diatomic molecule bonded to an individual atom or to another diatomic molecule via opposing magnetic polarities of the toroidal polarization of the orbits of individual atoms.

An important feature of magnecules is that *the magnetic polarization occurs in each individual atom*, rather than in a molecule as a whole. This implies that the new chemical species of magnecules can be formed for all possible gases irrespective of whether they are diamagnetic (such as hydrogen) or paramagnetic (such as oxygen).

Therefore, *the primary technological objective underlying the industrial and scientific production of substances with magnecular structure rests in the control of the space distributions of the orbits of individual atoms, rather than molecules.*

It should be noted that magnetic polarizations are *individually unstable*, because, as soon as the external magnetic field is terminated, the conventional space distribution of the orbits is reacquired due to rotations and other motions caused by temperature. However, *coupled* opposing magnetic polarities of two or more atoms are instead stable because, when the external magnetic field is removed, rotations and other motions due to temperature apply to the cluster of bonded atoms as a whole. As a result, magnecules are stable at ordinary temperatures and pressures.

It should also be noted that electric polarizations are essentially reducible to ellipsoidal deformations of electron orbits with consequential predominance of one charge at one end and the opposite charge at the other end. Whether individual or coupled, such ellipsoidal deformations are evidently terminated by collisions, rotations and other

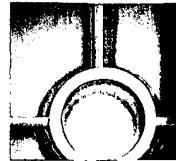
effects due to temperature, and this explains the dominance of magnetic over electric polarizations.

Nevertheless, the reader should keep in mind that no magnetic effect exists without an electric counterpart. Even though less relevant, electric polarizations cannot be ignored on strict scientific grounds. As a result, the term scientifically more appropriate for the new chemical species is that of "electromagnecules" [5].

Recall that all magnetic effects are known to cease at a temperature called the *Curie Temperature*. This is also the case for magnecules which decompose at a certain temperature varying from substance to substance, which temperature is generally of the order of the combustion temperature.

The new chemical species of magnecules most investigated until now is that of the combustible gas known under the name of *Santilli MagneGas™* produced via recyclers called *hadronic reactors of molecular type* [5]. This particular gas is produced by flowing a liquid feedstock (such as fresh or salt water, antifreeze and oil waste, city and farm sewage, crude oil, etc.) through a submerged electric arc between carbon-base consumable electrodes.

In essence, the electric arc separates the liquid molecules in part or in full, vaporizes the carbon of the electrodes, and forms a plasma of mostly ionized H, C and O atoms and their radicals such as CH and HO at about 10,000°F. The flow of the liquid continuously removes the plasma from the electrode tips and controls the subsequent thermochemical



reactions. The H, C and O atoms and their radicals are exposed to the extremely intense magnetic fields at *atomic distances* of the electric arc, by acquiring in this way a toroidal polarization of their orbits, as discussed in more detail later on.

The name "MagneGas" was introduced by the author to denote *all* gases with the new magnecular structure, thus including all combustible gases produced by submerged electric arcs within all possible liquid feedstocks, as well as magnetically polarized gases which are not necessarily combustible.

The resulting MagneGas has a magnecular structure (from which it derives its name) because it results to be constituted of clusters of individual H, C and O atoms, CH and OH radicals, single valence bonds C–O, double valence bonds C–O, and conventional molecules H₂ and CO (that with triple valence bond) with traces of O₂, CO₂, H₂O and other substances (see monograph [5, Chapters 7 and 8] for brevity).

3. Environmental relevance of the new species of magnecules

The new chemical species of magnecules has recently emerged as possessing considerable environmental relevance because it permits the industrial production of cost competitive new gaseous fuels whose combustion exhaust is so clean as to require no catalytic converters, as it is the case for MagneGas (see certification [9]). This important feature is due to the increased specific weight, enhanced thermochemical reactions, as well as the capability of eliminating hydrocarbon chains in a gaseous fossil fuel in favor of clean burning magnecular clusters with specific weight and energy output similar to those of the original gaseous hydrocarbon.

The increased specific weight caused by the new chemical species of magnecules is evident. Let us denote the conventional valence bond with the symbol “-”, the new magnetic bond with the symbol \times , and the magnetic polarization of generic atoms A, B, ... with the symbols A_{\uparrow} , A_{\downarrow} , A_{\uparrow} , A_{\downarrow} , etc. Suppose that the original gas has a conventional diatomic structure with valence bond A–B. Then, the creation of a magnecular structure in such a gas can be schematically represented:

$$(A_{\uparrow} - B_{\downarrow}) \times A_{\uparrow}, \quad (3.1a)$$

$$(A_{\uparrow} - B_{\downarrow}) \times (A_{\uparrow} - B_{\downarrow}), \quad (3.1b)$$

$$(A_{\uparrow} - B_{\downarrow}) \times (A_{\uparrow} - B_{\downarrow}) \times B_{\uparrow}, \text{ etc.}; \quad (3.1c)$$

with the understanding that the correct formulation should be that via columns, rather than rows, since the bond occurs between opposing polarities of different atoms as shown in Fig. 4.

It is then evident that the above magnecular structure increases the specific weight of the original gas. The actual

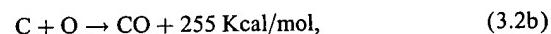
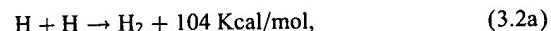
value of the increase depends on a variety of features indicated later on, including the intensity of the external magnetic field, the pressure of the gas, the duration of the gas treatment, and other factors.

Note that, while the original gas has the unique molecular structure A–B, the resulting new species has a variety of structures, again, depending on the used equipment and treatment. While the molecular structure A–B is constant, the corresponding magnecular structure is not constant in the sense that magnecules can break down into fragments due to collisions, and then recombine with other fragments forming different magnecules. This feature has been experimentally verified (see next section), and it is called *magnecular mutation* [5].

Therefore, *the specific weight of a gas with magnecular structure is a statistical average of the specific weight of all magnecules existing in the gas, and not that of one individual magnecule*. Despite these mutations, said magnecular specific weight is constant under constant conditions of pressure and temperature, as we shall see.

The increased energy content of combustible gases with magnecular structure, which is released in the thermochemical reactions of the combustion, is an evident consequence of the increased specific weight, as well as of the following new features:

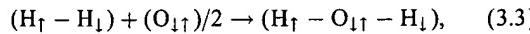
- (i) The presence in magnecules of individual uncoupled atoms, as established by experimental evidence [5], which atoms combine at the time of the combustion, thus releasing additional energy. For instance, MagneGas produced from liquid feedstocks of fossil origin has an energy content (in BTU/scf) up to three times that predicted by quantum chemistry, because its magnecular clusters contain isolated H, C and O atoms which, at the time of the combustion, recombine along the known reactions



thus releasing additional energy which is completely absent in a conventional molecular gas where the presence of isolated atoms is prohibited by nature.

- (ii) Polarized atoms release energy in their thermochemical reactions in amount greater than that released by unpolarized atoms. Consider, for instance, the water molecule H₂O = H–O–H where the individual H–O and O–H radicals have the characteristic angle of 104 degrees. As is well known, the orbits of the two dimers H–O and O–H have a distribution which is perpendicular to the plane of the molecule H–O–H, as illustrated in Fig. 2. This implies that, in order to become part of the water molecule, an H atom must first reduce its space distribution to a toroidal form, precisely as

existing in magnecules. It then follows that a polarized H atom releases more energy when bonding with oxygen as compared to the energy released by unpolarized atoms, the excess energy being given by that needed for the proper polarization. Differently stated, the reaction



where the two orientations in the oxygen $O_{\uparrow\uparrow}/2 \rightarrow$ occur at 104° angle, is predicted to release more Kcal/mol than the conventional value 57 Kcal/mol of reaction (3.2c) among unpolarized atoms. By remembering that the actual structure of water remains vastly unknown following about 150 years of quantitative research, it has been conjectured in Ref. [5] that the actual structure of the water molecule is given by the combination of molecular and magnecular bonds ($H_{\uparrow} - O_{\uparrow\uparrow} - H_{\downarrow}$), as illustrated in Fig. 2, plus rotations and other motions due to temperature. In fact, such a model verifies the indicated experimental evidence of the perpendicular character of the orbits of the H–O and O–H radicals with respect to the molecular plane H–O–H, represents the diamagnetic nature of the water molecules, and permit a quantitative-numerical representation of the binding energy, electric and magnetic moments of the water molecule which, for the first time in chemistry, is accurate to the desired digit [2,3,5].

- (iii) Magnetically polarized diatomic molecules with a sufficient number of electrons can acquire new internal bonds due to the magnetic polarization of non-valence electrons, with consequential additional energy storage. This feature has been experimentally detected for the case of the CO molecule exposed to intense magnetic fields which shows under infrared scans the presence of *two new IR peaks* (see later on Fig. 8). These new peaks evidently characterize new bonds besides those characterized by conventional valence couplings. Since all available valence electrons are used in the triple valence bonds of the CO molecule, the new peaks can only be explained with the toroidal polarization of internal non-valence electrons, resulting in new magnetic bonds North–South–North–South, as illustrated in Fig. 5. Since every atomic bond implies an energy storage, it is evident that this third feature constitutes a third novel method for energy storage. Note that the latter method is also applicable to *inert gases* which, in this way, can indeed store energy (although not of thermochemical nature), contrary to a rather popular belief.

Needless to say, some of the above bonds have a *negative* binding energy. The important aspect is that the *combined effects* due to magnecular clustering implies an increased energy content. Equivalently we can say that the weaker nature of the magnecular over the molecular bond directly implies an increased energy output under combustion. This is due to the presence of H, C and O isolated atoms under a magnecular bond weaker than the molecular one, thus

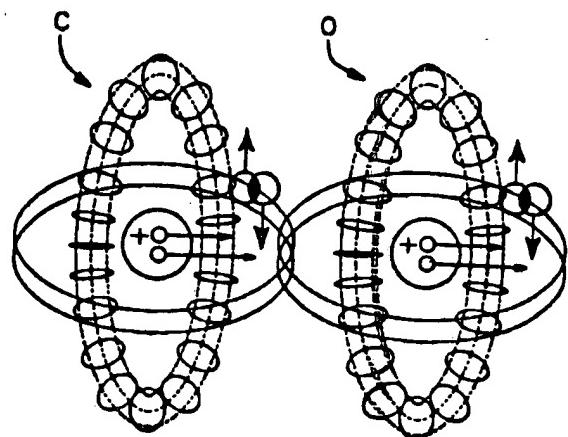


Fig. 5. A schematic view of a conceivable interpretation of new infrared peaks existing in the CO molecules exposed to very intense magnetic field as shown in Fig. 8. Since each peak requires a new internal force and all valence electrons are used in the triple bond of the CO molecule, the attractive force responsible for the new peaks *cannot* be of valence type. It is, therefore, conjectured that, since the CO molecule was exposed to strong magnetic field, the new attractive force originates from the toroidal polarization of the orbits of internal non-valence electrons in both the C and O atoms, thus producing new bonds from opposing magnetic polarities. Note that the model of this figure is extendable to other molecules (note the exclusion of the hydrogen molecule for this new internal bond due to the lack of the necessary electrons in addition to those for valence bonds).

permitting the formation under combustion of conventional molecules H_2 , CO , H_2O , etc. and consequential release of energy which would be otherwise absent.

A further possibility for increased energy output for combustible gases with magnecular structure is due to the apparent weakening of conventional valence or covalence bonds within magnecular clusters. This feature is supported by the experimental evidence of up to 15% oxygen in the combustion exhaust of MagneGas which would be impossible in the event all its CO content has the conventional triple valence bond.

As a result of these and other aspects, it then follows that combustible gases with magnecular structure are definitely preferable over those with conventional molecular structure.

For details in these aspects we refer the interested reader to papers [8]. The particular case of breaking down hydrocarbon chains and their replacement with clean burning magnecular clusters (international patents pending) requires a specialized study in a future paper.

4. Experimental evidence for the new species of magnecules

The experimental detection of *magnecules* is rather difficult, thus requiring particular scientific care before

venting judgments, because all available analytic equipment has been conceived, tested and extensively used for the detection of the different chemical species of molecules.

Some of the difficulties are due to the fact that magnecules are less stable than molecules, particularly at high temperatures, and actually cease to exist at their Curie Temperature. As a result, numerous analytic equipment decompose magnecules into their conventional molecular constituents, thus giving the perception of lack of novelty, while in reality no measure of the species to be detected has actually occurred.

Other difficulties are due to the fact that the detecting means of various analytic equipment stimulate the recombination of isolated atoms (such as C and O) into conventional molecules (such as CO), thus resulting in the detection of substances which, in reality, do not exist in the species to be tested. A clear illustration is given by infrared measurements of MagneGas produced from antifreeze as liquid feedstock which have systematically indicated the apparent presence of about 47% of CO. This result is soon proved to be a mere "experimental belief" by the analyst, because the combustion exhaust of magnegas (which is fully molecular because beyond the magnecules Curie temperature) contains about 5% of CO₂, rather than the 35% CO₂ needed for the combustion in atmosphere of a gas containing 47% CO.

What has in reality happened is that the analytic equipment itself has altered the species to be tested, by turning individual C and O atoms, single valence bonds C—O and double valence bonds C=O present in the magnecules into the conventional (triple valence bonds) CO detected by the instrument.

Other difficulties are due to the extrapolation of measurements which are generally true for molecular, but not for magnecular substances. An illustration is given by the use of infrared analytic equipment which can only detect individual radicals, rather than complete molecules. For the case of a conventional molecular species the extrapolation of a radical (such as H—O) to the corresponding molecule (such as H₂O) is certainly correct. However, for the case of a gas created under strong magnetic fields, such as MagneGas, such extrapolation is a pure personal belief by the analyst, rather than an experimental measurement. This occurrence is due to the fact that MagneGas contain individual radicals (such as H—O) without the corresponding complete molecule, due to the evident partial decomposition of the water molecule by the electric arc, and the trapping of its fragments in magnecules.

At any rate, claims for the existence of a given percentage of water (as well as hydrocarbons and other substances) in MagneGas achieved via infrared measurements are soon dismissed as "experimental beliefs" by the absence of corresponding peaks in mass spectrometry.

Other difficulties occur in the use of micrometric feeding lines which are certainly acceptable for tests of gases with conventional molecular structure, but not for gases with magnecular structure. In fact, there is significant experimen-

tal evidence of anomalous adhesion to the walls of instruments even for the case of diamagnetic molecules, which occurrence is called magnecular adhesion [5]. Moreover, magnecules of what are generally considered to be light gases have been detected to exist all the way to 1000 a.m.u. and more. Therefore, the interior walls of micrometric feeding lines are soon clogged up by small magnecules in said anomalous adhesion, as a result of which the heavy species to be tested is prevented even by micrometric feeding lines from entering the instrument, let alone be tested.

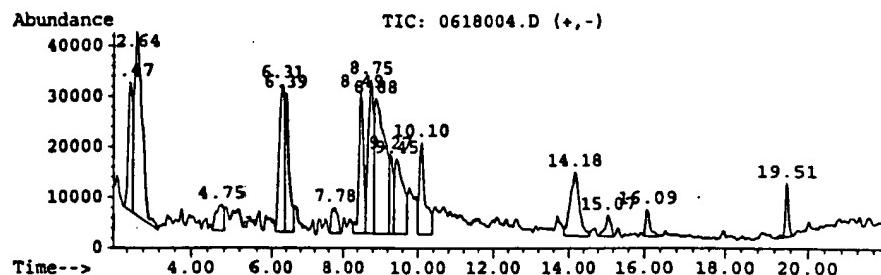
This occurrence is particularly severe for liquid magnecules which can have a specific weight of tens of thousands a.m.u. The use of micrometric feeding lines in liquid chromatography then yields the "experimental belief" that the magnecules do not exist, as often experienced by the author at some of the best analytic laboratories, when in reality the magnecules were detectable by a microscope or even by the naked eye (e.g., as dark spots in liquids originally transparent [5]). Again, the sectional area of the feeding line was so small to prevent the species to be tested even to enter the instrument, let alone conduct measurement of scientific value.

When magnecules are actually detected, analysts often conclude that the instrument is malfunctioning because the blank after the test shows peaks essentially identical to those of the actual scans. In reality, this feature is considered a necessary condition for the detection of magnecules (depending on the instrument used) because of their anomalous adhesion throughout the interior of the instrument, which adhesion is so pervasive to require flushing with an inert gas at high temperature.

It then follows that no analytic test on magnecules can be considered complete without the following: (1) print-outs of the blank prior to any feeding of a magnecular gas to verify the absence of any species; (2) print-outs of scans while feeding the magnecular gas; and (3) print-outs of the blank following the removal from the instrument of the magnecular gas to verify that at least some of the magnecular species have remained in the instrument via anomalous adhesion.

Additional difficulties are due to the possible elusion of various species all superimposed in one or more peaks, a feature occurring in particular for the short elusion times typical of recent analytic equipment. In this case the analyst slices the peaks and, in so doing, essentially identifies the individual constituents of the species, and not the species itself. These constituents are generally given by ordinary molecules, resulting in a claim of lack of novelty, when in reality the chemical species constituting the magnecular gas had not separated, as necessary for a scientific result. In turn, this feature requires the use of analytic instruments with the longest possible elusion time, generally of the order of 20 min or more, a feature which is un-necessary for the test of molecules.

Stated in different terms, analytic measurements of magnecules put the emphasis where it should be, in the proper separation and identification of each peak, rather than the



Retention Time	Area	Area %	Ratio %
Total Ion Chromatogram			
2.474	1753306	5.386	32.724
2.644	5091514	15.641	95.030
4.754	641528	1.971	11.974
6.307	2737749	0.411	51.098
6.390	2211258	6.793	41.272
7.782	592472	1.820	11.058
8.490	2357336	7.242	43.999
8.754	2784829	8.555	51.977
8.882	5357812	16.460	100.000
9.265	1123809	3.452	20.975
9.448	2421234	7.438	45.191
10.098	1946292	5.979	36.326
14.177	2129791	6.543	39.751
15.073	435208	1.337	8.123
16.085	389822	1.198	7.276
19.509	577433	1.774	10.777

Fig. 6. A typical GC-MS scan from 40 a.m.u to 400 a.m.u. of a gas with magnecular structure obtained on June 19, 1998 at the analytic laboratory of *National Technical Systems* at the *McClellan Air Force Base* in Sacramento, California, via the use of a HP GC model 5890, a HP MS model 5972 and a HP IRD model 5965, the equipment being operated under conditions quite unusual for conventional molecular gases identified in Ref. [5]. The peculiarity of the above MS scan is that the tested MagneGas was produced from an electric arc between consumable graphite electrodes submerged within pure water (also known as "AquaFuel"), in which case the heaviest molecular species is CO₂. Therefore, the scan here considered should have solely shown a peak at 44 a.m.u. On the contrary, the latter peak is unidentifiable and replaced by a variety of peaks in macroscopic percentages none of which was identified by the computer following a search among all molecules existing in the memory banks of the McClellan Air Force Base (see Ref. [5, Chapter 8 for details]).

identification of their constituents, because, when properly tested, each identifiable chemical species results in an identifiable peak, and not in a collection of peaks.

For these and several other difficulties in detecting *magnecules* with *molecular* analytic equipment, methods and insights, we refer the interested reader to monograph [5, Chapter 8].

With the understanding that analytic equipment specifically conceived, developed and tested for the detection of magnecules does not exist at this writing, the most effective equipment identified by the author after considerable search is given by gas chromatographic mass spectrometers (GC-MS) necessarily equipped with infrared detectors (IRD), and generally referred to as GC-MS/IRD.

The joint use of an IRD attached to the GC-MS is truly mandatory for a serious detection of magnecules. In essence, the sole GC-MS detection of a conventional molecule is not sufficient for its identification on rigorous scientific grounds, because there is the need of at least one independent verification. An effective alternative method for such a verifi-

cation is the IRD. When, and only when, the identification of the *same* peak is established in *both* the GC-MS and the IRD, then, and only then, the analyst can express a serious scientific result, because various possible alternative interpretations may occur when only one of these two methods is used.

In the transition to tests of magnecules the need for the joint use of GC-MS equipped with IRD becomes mandatory. In fact, *only the GC-MS/IRD permits the test of the same peak under both MS and IR scans*. If two separate instruments are used, namely, a GC-MS and, separately, an IRD, the above joint MS and IR tests of the same peak is impossible, resulting in a plethora of ambiguities with consequential departure from true experimental settings.

The need for the joint GC-MS/IRD for the analytic detection of magnecules is also mandatory because of the general tendency of identifying any MS peak with one or another *molecule*, identification which is eliminated for the case of magnecules by the test of the same peak with the IRD, as illustrated below.

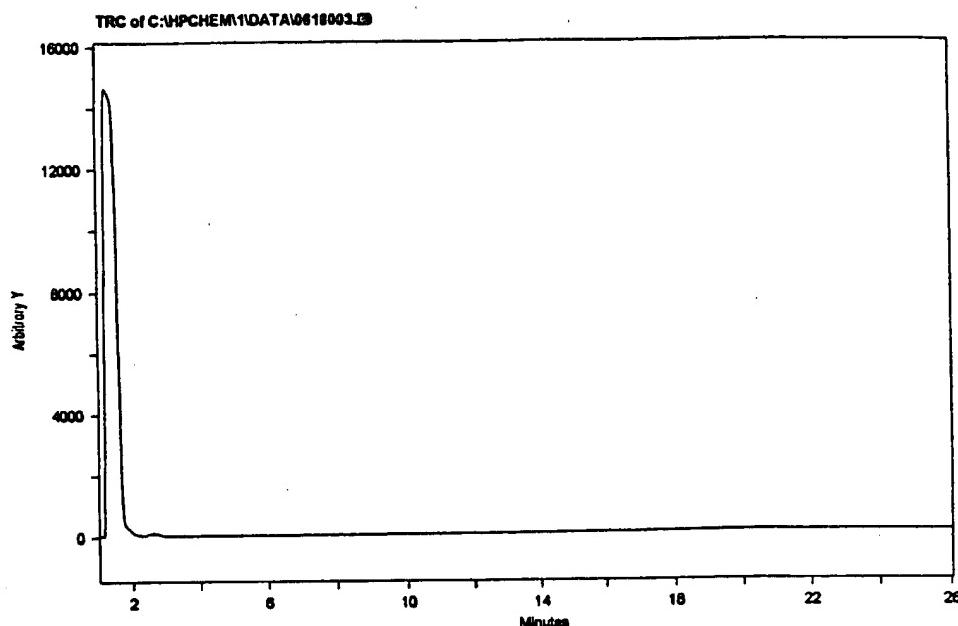


Fig. 7. The IR signature of MS scan of the preceding figure (under the same conditions, for the same gas and for the same range of 40–400 a.m.u.) confirming that the sole conventional molecule contained in the tested gas is CO_2 at 44 a.m.u., and that all anomalous peaks of the MS scan of Fig. 6 have no IR signature at all. These features establish beyond *credible* doubt the emergence of a new chemical species *not* based on any of the various types of valence, the *only* open scientific issue being its proper identification. The magnecular hypothesis remains the sole possible following the elimination of valence bonds, due to the creation of the gas under the very intense magnetic fields at atomic distance from electric arcs (see later on for more details).

Also, numerous GC-MS/IRD equipment of recent construction has been found to be inadequate to detect magnecules because of various reasons, such as: their detection means destroy the magnecules to be detected (as is the case for detection via strong ionization beams); the elusion time is excessively short; the type of admitted column is insufficient (e.g., because its sectional area is inappropriate for large magnetically polarized magnecules); and for other reasons.

The best GC-MS/IRD identified by the author after considerable search are given by the old HP GC model 5890, HP MS model 5972 and HP IRD model 5965 operated with special precautions indicated in Ref. [5], such as: the use of the largest possible feeding lines; the cryogenic cooling of the latter; the selection of the appropriate type of column with the appropriate sectional area; the use of the column at the lowest admissible operating temperature; the use of the longest possible elusion time; and other requirement which are inessential for molecules, yet essential for magnecules.

With a clear understanding of the scientific caution needed to avoid “experimental beliefs”, magnecules are generally detected via MS peaks in macroscopic percentages (that is, clearly above the background), which peaks result to be unknown following computer search among all known molecules (Fig. 6), the same peaks having no signature under the IRD at the atomic weight of the MS peak, the

only IR signatures being those of the much lighter radicals and molecules constituting the cluster (Figs. 7 and 8).

The lack of IR signature for magnecules establishes that the peaks detected in the GC-MS cannot possibly be molecules, particular for the case of large clusters with atomic weight of the order of hundreds of a.m.u. for which spherical symmetry (necessary to have no IR signature) cannot be credibly suspected. After eliminating valence bonds, the only remaining possibility for explaining the internal attractive force necessary to create magnecules is that such forces are of magnetic and electric nature, thus implying the birth of the new chemical species of electromagnecules.

The reader should be aware of the existence of a vast number of experimental measurements on magnecules which could be only partially reproduced in monograph [5], let alone in this paper. This evidence establishes the anomalous *magnecular adhesion* (indicated earlier), the equally anomalous *magnecular mutation* (change of magnecules in time), and other anomalies.

The latter occurrence was proved via test with the GC-MS/IRD on MagneGas produced from water as liquid feedstock (also known as Aquafuel) via: (1) the recording of the MS spectrum at one time; (2) The recording of the MS spectrum 30 min later which showed dramatic changes in the preceding spectrum even though all conditions and feeding remained unchanged; and (3) The verification that

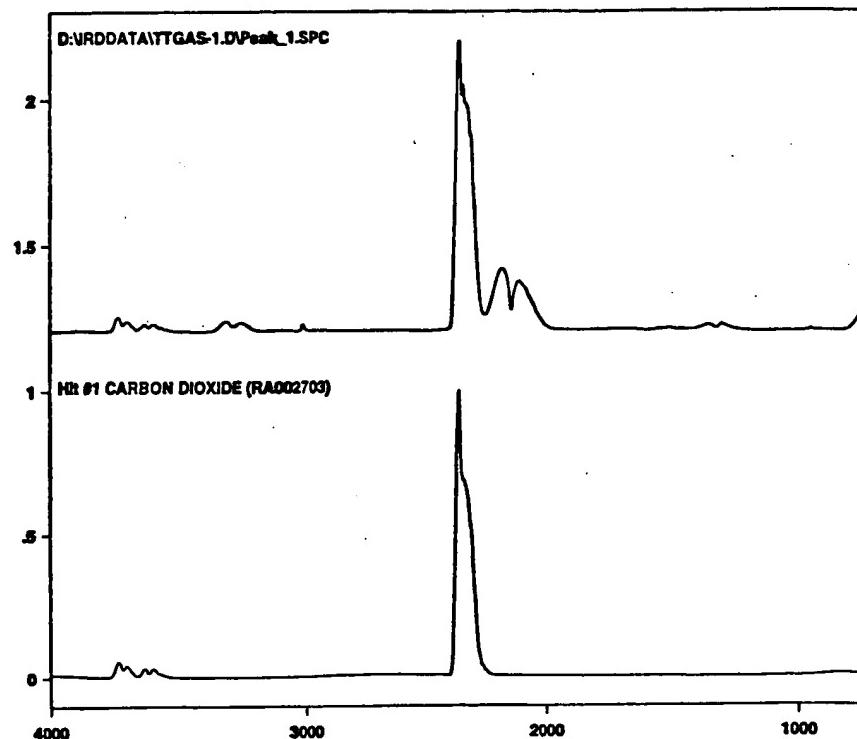


Fig. 8. A reproduction of the IR scan of a magnetically polarized CO gas conducted at the Pinellas County Forensic Laboratory in Largo, Florida, on July 25, 1998, via the use of a HP GC model 5890-II, a HP MS model 5970 and a HP IRD model 5965B. Note the appearance of two additional IR peaks (top view) which are absent in the conventional unpolarized molecule (bottom view). The creation of new internal bonds within a conventional molecule which are not of valence type is, therefore, beyond credible doubt, the only open scientific issue being the identification of their new origin. Once valence bonds are eliminated, the only plausible interpretation known at this writing is that via internal magnetic bonds as illustrated in Fig. 5.

the IR signature of both scans remained unchanged, thus confirming that the mutation has occurred solely in the *magnecular clusters*, and not in any valence substance.

The above mutations have also established the presence in magnecules of individual uncoupled atoms, e.g., because of numerous increases or decreases of peaks by one a.m.u., establishing the accretion or loss of one H atom, with similar numerical changes for C and O atoms, or for H–O, C–H and other radicals.

Additional characteristics established by this experimental evidence relates to the equally anomalous *mutation of physical properties* for magnetically polarized substances, including macroscopic changes in specific densities, visible alterations in chemical reactions and other anomalies.

5. The hypothesis of the new chemical species of MagneHydrogen™ and MagneOxygen™ (international patents pending)

In this paper we submit, apparently for the first time, the hypothesis that conventional hydrogen H₂ and oxygen O₂ gases can be turned into a new species with

magnecular structure here called *MagneHydrogen™* and *MagneOxygen™*, or *MagneH™* and *MagneO™* (for short (international patents pending).

The foundations of the above hypothesis are essentially those given in preceding sections. As recalled earlier, the hydrogen molecule is diamagnetic and, therefore, it *cannot* acquire a total net magnetic polarity. Nevertheless, the orbits of the *individual H atoms* can acquire a toroidal polarization under a sufficiently strong external magnetic field. The opposite magnetic moments of the two H atoms then explain the diamagnetic character of the hydrogen molecule as illustrated in Fig. 1.

The aspect important for the hypothesis of MagneH and MagneO is that the toroidal polarization of the orbits of the electrons of the individual H atoms, plus the polarization of the intrinsic magnetic moments of nuclei and electrons in the H₂ molecule is sufficient for the creation of the desired new chemical species with bigger specific weight, because the new bonds can occur between pairs of individual H atoms, as illustrated in Fig. 4.

The creation of MagneO is expected to be considerably simpler than that of MagneH because oxygen is paramagnetic, thus having electrons free to acquire an overall

magnetic polarity which is absent for the case of MagneH. Nevertheless, the achievement of a significant increase of the specific weight of the oxygen will require the toroidal polarization of at least some of the peripheral atomic electrons, in addition to a total magnetic polarization.

The primary technological objective is therefore that of achieving physical conditions and geometries suitable for the joint polarization of *atoms*, rather than molecules, which favors their coupling into chains of opposing magnetic polarities (Fig. 9). In the final analysis, the underlying principle here is similar to the magnetization of a ferromagnet, which is also based on the polarization of the orbits of unbounded electrons. The main difference (as well as increased difficulty) is that the creation of MagneH requires the application of the same principle to a *gaseous*, rather than a solid substance.

Under the assumption that the original gases are essentially pure, MagneH can be schematically represented

$$(H_{\uparrow} - H_{\downarrow}) \times H_{\uparrow}, \quad (5.1a)$$

$$(H_{\uparrow} - H_{\downarrow}) \times (H_{\uparrow} - H_{\downarrow}), \quad (5.1b)$$

$$(H_{\uparrow} - H_{\downarrow}) \times (H_{\uparrow} - H_{\downarrow}) \times H_{\uparrow}, \text{ etc.} \quad (5.1c)$$

while MagneO can be schematically represented

$$(O_{\uparrow} - O_{\downarrow}) \times O_{\uparrow}, \quad (5.2a)$$

$$(O_{\uparrow} - O_{\downarrow}) \times (O_{\uparrow} - O_{\downarrow}), \quad (5.2b)$$

$$(O_{\uparrow} - O_{\downarrow}) \times (O_{\uparrow} - O_{\downarrow}) \times O_{\uparrow}, \text{ etc.} \quad (5.2c)$$

where the arrows now indicate possible polarizations of more than one electron orbit.

By keeping in mind the content of the preceding sections, the achievement of the above magnecular structure does imply that MagneH and MagneO have specific weight and energy content greater than the corresponding values for unpolarized gases. The numerical values of these expected increases depend on a variety of factors discussed in the next section, including the intensity of the external magnetic field, the pressure of the gas, the time of exposure of the gas to the external field, and other factors.

A first important feature to be subjected to experimental verification (reviewed later on) is the expected increase of specific weight. By recalling that the gasoline gallon equivalent for hydrogen is about 383 scf, the achievement of a form of MagneH with five times the specific weight of conventional hydrogen would reduce the prohibitive volume of 7660 scf equivalent to 20 g of gasoline to about 1500 scf. This is a volume of MagneH which can be easily stored at the pressure of 4500 pounds per square inch (psi) in carbon fiber tanks essentially similar in volume to that of a gasoline tank. As a result, the achievement of MagneH with sufficiently high specific weight can indeed eliminate the

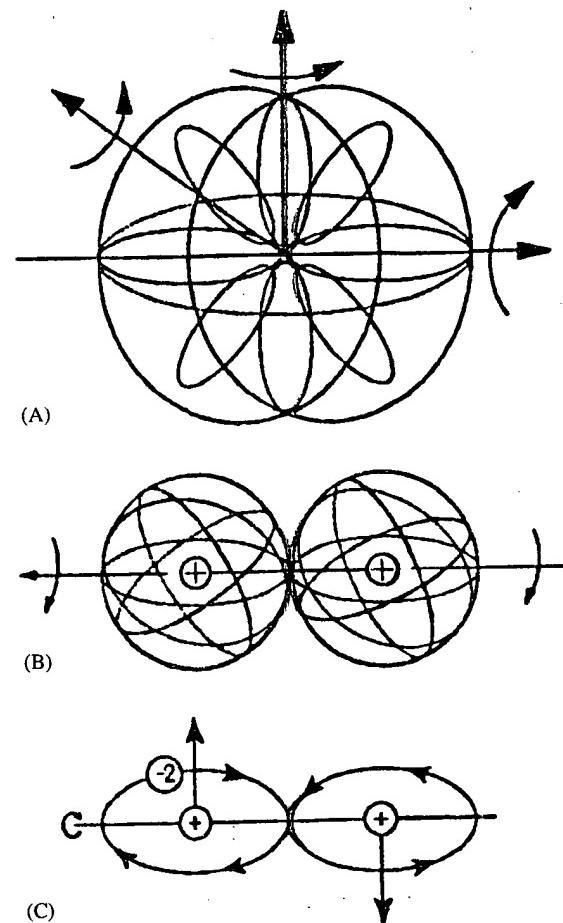


Fig. 9. A schematic view of the main steps in the magnetic polarization of the hydrogen molecule. Due to rotations in all space directions, the H_2 molecule has a spherical symmetry (responsible for its lack of IR signature) with the radius of the order of magnitude of the diameter of the H atom (again, when referred to orbits rather than orbitals), as in View A. The main technological objective for the creation of MagneH is the removal of *all* rotations. This process is schematically represented in this figure via the use of an external magnetic field (not shown for simplicity) suitable to create the reduction of the molecule, first, to two discernible H atoms, as in View B, and then to the planar configuration of View C via the elimination of the rotations of the individual H atoms. The final state is a structure which, in semiclassical approximation and at absolute zero degree temperature, the electrons orbits are located in a plane. We recover in this way the physical law that, in the absence of external perturbations or quantum uncertainties, orbits are distributed within a plane, as it is the case for planetary orbits. When quantum uncertainties are added in the presence of a strong external magnetic field, the exactly planar configuration is evidently lost in favor of a toroidal configuration, thus recovering in this way the main feature of the new chemical species of MagneH, as studied in detail in Refs. [5,8].

expensive liquefaction of hydrogen in automotive use, with consequential reductions of costs.

Another basic feature to be subjected to experimental verification (reviewed later on) is that the combustion of MagneH and MagneO releases more energy than the combustion of conventional H and O gases, particularly when all features (i), (ii) and (iii) of Section 3 are realized. It then follows that

- (I) the use for internal combustion engines of MagneH with a sufficiently high specific weight is expected to eliminate liquefaction, yield essentially the same power as that produced with gasoline, and produce a dramatic decrease of operating costs;
- (II) the use of MagneH and MagneO in fuel cells is expected to yield a significant increase of voltage, power and efficiency; and
- (III) the use of liquefied MagneH and MagneO as fuels for rocket propulsion is expected to permit an increase of the payload, or a decrease of the boosters weight with the same payload.

Moreover, recent studies scheduled for a separate presentation have indicated that the *liquefaction of MagneH and MagneO appears to occur at temperatures bigger than those for conventional gases*, thus implying an additional reduction of costs. This expectation is due to the fact that magnecules tend to aggregate into bigger clusters with the increase of the pressure, evidently due to their magnetic polarizations, which feature evidently favors liquefaction.

The experimental evidence supporting this expectation is that, while compressing a gas with magnecular structure, there is an increase of the volume needed for the same pressure increase although at increased pressures. Specifically, measurements have established that the compression of MagneGas in a high pressure cylinder which may require 40 scf of MagneGas for the increase from 100 to 200 psi, the compression of the same gas in the same cylinder from 3000 to 3100 psi will require about 50 scf.

In turn, these features establish that *gases with magnecular structure have nonlinear deviations from the perfect gas law, and their Avogadro number is not constant with the variation of pressure, temperature and volume*. All these anomalies, which are beyond any credibility for molecular structure, are easily explained for magnecules by their breakdown into fragments due to collisions, their recombination with other fragments, and their tendency to aggregate with increase of the pressure, with the consequential decrease of the Avogadro number.

It is evident that the same principles outlined above also apply for other gases, and not necessarily to H and O gases alone. In fact, the processing of any gaseous fossil fuel via the principles here considered permits the increase of its specific weight as well as of its energy output, thus permitting a consequential decrease of storage volume, increase of performance and decrease of costs.

6. The new magnecular interpretation of H₃ and O₃

As is well known, a species with molecular weight of about 3 a.m.u., corresponding to H₃, is routinely detected in GC-MS scans, while O₃ has been known for over one century under the name of ozone. These species are generally interpreted as being due to some form of valence bonds. In this section we point out that such a valence interpretation may imply the violation of a number of laws in particle physics. On the contrary, the magnecular interpretation as in Eqs. (5.1a) and (5.2a) appears to resolve these problematic aspects. At any rate, the existence of the species H₃ and O₃ provides evident support for the existence of species with bigger molecular weight.

A triple valence bond for H₃ may imply the violation of Pauli's exclusion principle (and other physical laws), because, under our strong valence bond, it would imply the bond of a third electron to a pre-existing valence pair. In turn, this would imply the existence of at least two electrons with the same quantum numbers in the same energy level, an occurrence clearly prohibited by Pauli's exclusion principle.

The assumption of a weaker notion of valence (such as that of contemporary quantum chemistry) would indeed permit a form of valence bond for the third hydrogen atom in the H₃ structure. However, such a model would have other inconsistencies, such as the prediction that the hydrogen molecule is paramagnetic, as studied in detail in Ref. [5].

Independently from that, various laws in particle physics prohibit a bond between a valence electron pair (which is necessarily a Boson due to its singlet nature) and a third electron (which is a Fermion). In any case, vast experimental evidence has established that valence correlations-bonds only occur in pairs. Serious studies of the valence origin of the H₃ bond would, therefore, require a basic revision of the entire valence theory.

This and other violations of basic physical laws can be resolved with the interpretation that H₃ has the magnecular structure

$$H_3 = (H_{\uparrow} - H_{\downarrow}) \times H_{\uparrow}. \quad (6.1)$$

In this case only two electrons are bonded into a singlet pair with the same energy although antiparallel spins as requested for the verification of Pauli's principle, while the electron of the third H atom is magnetically bonded to one of the other two H atoms, thus being in an energy state different from that of the preceding valence pair, with consequential lack of applicability of Pauli's exclusion principle.

In the case of ozone O₃, the molecule O₂ possesses free electrons for possible additional valence bonds. Nevertheless, the possible violation of Pauli's exclusion principle for triple valence bonds remains. Also, as discussed in detail in the next section, the origin of ozone (notoriously achieved via electric discharges) indicates the presence at its creation of strong magnetic fields, with consequential toroidal polarization of the orbits of at least some of the valence electrons.

It then follows that the magnecular structure of the ozone

$$\text{O}_3 = (\text{O}_\uparrow - \text{O}_\downarrow) \times \text{O}_\uparrow, \quad (6.2)$$

with internal coupling similar to those of the magnecule (6.1), cannot be ruled out.

The plausibility of the magnecular interpretation of H_3 and O_3 provides grounds for the search for similar magnecular structures with bigger number of atomic constituents, which is the central objective of this study.

7. Industrial production of MagneHydrogen™ and MagneOxygen™ (international patents pending)

As indicated earlier, the magnetic polarization of the orbits of peripheral atomic electrons requires extremely strong magnetic fields of the order of billions of Oersted which are of simply impossible realization in our laboratories with current technologies, that is, at distances of the order of inches or feet. These magnetic fields cannot be realized today even with the best possible superconducting solenoids cooled with the best available cryogenic technology.

The only possible, industrially useful method of achieving magnetic fields of the needed very high intensity is that based on direct current (DC) electric arcs with currents of the order of thousands of Amperes (A) when considered at atomic distances, i.e., of the order of 10^{-8} cm. As illustrated in Fig. 10, the magnetic field created by a rectilinear conductor with current I at a radial distance r is given by the well known law

$$B = kI/r, \quad (6.1)$$

where $k = 1$ in absolute electromagnetic units. It then follows that, for currents in the range of 10^3 A and distances of the order of the size of atoms $r = 10^{-8}$ cm, the intensity of the magnetic field B is of the order of 10^{13} Oersted, thus being fully sufficient to cause the magnetic polarization of the orbits of peripheral atomic electrons.

Under the above conditions schematically represented in Fig. 10, atoms with the toroidal polarization of their orbits find themselves aligned one next to the other with opposing polarities which attract each other, thus forming magnecules. The electric arc decomposes the original molecule, thus permitting the presence of isolated atoms or radicals in the magnecular structure as needed to increase the energy output (Section 3).

In this way, the process transforms the original gas with its conventional molecular structure into a new, chemical species consisting of individual atoms, radicals and complete molecules all bonded together by attractive forces among opposite magnetic polarities of the toroidal polarization of the orbits of peripheral atomic electrons.

In the event the original gas has a simple diatomic molecular structure, such as H_2 , the magnecular clusters are composed of individual polarized H atom and ordinary polarized molecules H_2 as in Fig. 4. In the event the original gas has the more complex diatomic structure of O_2 , the magnecular

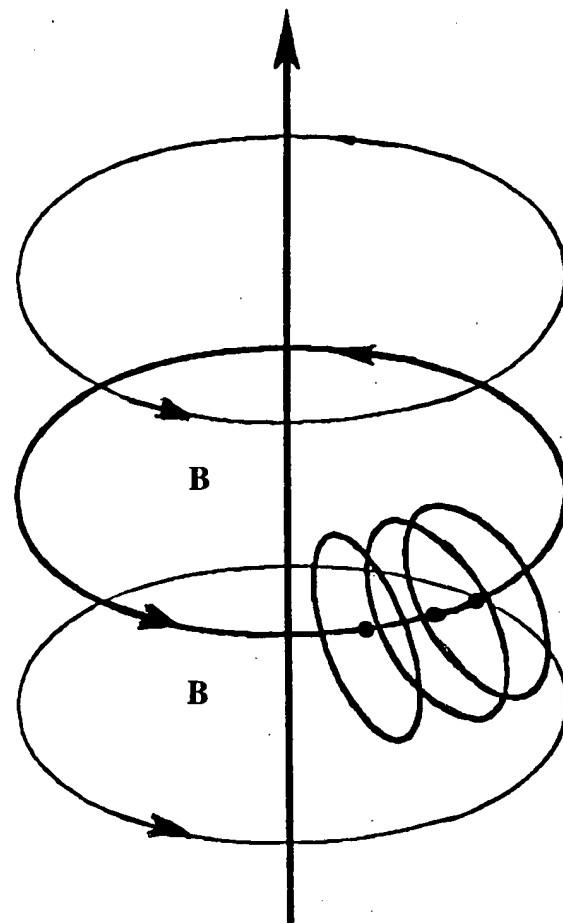


Fig. 10. A schematic view of the geometry of the magnetic field B at atomic distances from an electric arc. Note the counterclockwise circular geometry of the field, its extremely high intensity, the consequential toroidal polarization of atomic orbits (here schematically represented with circles), the consequential compression of various polarized atoms in the same magnetic line, and the resulting bonds of the latter into clusters, called Santilli magnecules, via the strongly attractive forces of opposing polarities.

clusters are composed of individual polarized O atoms, $\text{O}-\text{O}$ single bonds, and O_2 molecules with additional internal bonds as in Fig. 5. In the event the original gas has the more complex diatomic structure CO with triple valence bonds, the magnecular clusters are more complex and are generally composed of individual C and O atoms, single bonds $\text{C}-\text{O}$, double bond $\text{C}=\text{O}$, conventional molecules CO and O_2 with internal new bonds as in Fig. 5, plus possible C-complexes. Original gases with more complex conventional molecular structure evidently imply more complex magnecular clusters with all possible internal atomic arrangements.

It is evident that the resulting new species is not composed of all identical magnecules, and it is composed instead of a variety of magnecules from a minimum to a maximum

number of atomic components, which have been measured to reach 1000 a.m.u. and even more. The specific weight of the magnecular gas is then given by the average weight of all different magnecules, as indicated earlier.

Needless to say, a number of alternative methods for the industrial production of MagneH and MagneO are possible as identified in the existing patent applications. An alternative method worth mentioning here is the use of solenoids. The reader should however be aware that the latter cannot decompose molecules. Therefore, the MagneGases produced via the use of electric discharges and solenoids are different.

Another type of MagneH important for this study is that obtained from MagneGas [5]. When MagneGas is produced from a hydrogen rich liquid feedstock (such as water or liquids of fossil origin), it may contain up to 60% hydrogen in a form already polarized by the electric arc used for its production. Therefore, the hydrogen content of MagneGas is indeed a particular form of MagneH which can be separated via a variety of available technologies, such as filtration, cryogenic cooling and other processes.

This particular form of MagneH (whose features are identified in the next section) is particularly suited as fuel for internal combustion engines, rather than for fuel cells. This is due to the expected presence of very small C and O impurities which do not permit their use in fuel cells.

This particular type of MagneH derived from MagneGas has already been tested for automotive usage and proved to have a performance essentially similar to that of gasoline without any need of liquefaction, as needed instead by hydrogen vehicles currently tested by BMW, GM and other automakers. The tests were conducted via the conversion of two Honda and one Ferrari cars to operate on the new fuels (see [5] for brevity).

Above all, this particular type of MagneH has resulted to be cost competitive with respect to fossil fuels, of course, when produced in sufficiently large volumes. This cost competitiveness is due to a variety of factors, including (see [5] for detail):

- (1) the use of hydrogen rich wastes as liquid feedstock, such as city and farm sewage, antifreeze and or oil waste, etc., which implies an *income*, rather than a cost;
- (2) the possible utilization of steam at 400°C produced by the cooling of the highly esoenergetic processes of the reactors, which steam can be used for other *income producing applications*, such as desalting seawater via evaporation, production of electricity via turbines, heating of buildings, and other income producing uses; and
- (3) the unusually high efficiency of Santilli hadronic reactors of molecular types used for the process which brings the cost of electricity down to 0.005/scf.

Specific equipment and designs for the industrial production of MagneH, MagneO, and other magnetically polarized gases are available on request.

8. Experimental evidence on MagneHydrogen™ and MagneOxygen™

It is now important to review the experimental evidence supporting the existence of MagneH and MagneO. For this purpose the author had constructed by technicians in Florida a rudimentary apparatus based on the use of automotive sparks powered by an ordinary car battery, the system operating at about 15 psi. Two types of MagneO, denoted by MagneO1 and MagneO2, were produced from pure oxygen for comparative purposes.

This type of MagneO was tested in lieu of ordinary oxygen in a 2-cell proton exchange membrane (PEM) fuel cell operated with conventional high purity hydrogen. The membrane material was Nafion 112; the catalyst in the electrodes was platinum acting on carbon; the plates for heat transfer were given by two nickel/gold plated material; the temperature of the fuel cell was kept constant via ordinary cooling means; the current was measured via a HP 6050A electronic load with a 600 W load module; a flow rate for oxygen and hydrogen was assigned for each current measurement; both oxygen and hydrogen were humidified before entering the cell; the measurements reported herein were conducted at 30°C.

The results of the measurements are summarized in Figs. 11–13 which report relative measurements compared to the same conditions of the cell when operated with ordinary pure oxygen. As one can see, these measurements show a clear increase of the voltage, power and efficiency of the order of 5% when the cell was operated with MagneO1 and MagneO2. The increase was consistent for both samples except differences within statistical errors.

To appraise these results, one should note that the types of MagneO used in the test were produced via rudimentary equipment based on intermittent sparks operated with an ordinary automotive battery, and with the pressure limited to 15 psi. By comparison, the industrial production of MagneO should be done with an array of arcs each operated with continuous currents of thousands of Amperes, and at pressures of thousands of psi. It is evident that the latter conditions are expected to imply a significant increase of the performance of the fuel cells when operated with MagneO. Still bigger increases in voltage, power and efficiency occur when the fuel cells are operated with both MagneO and MagneH for the reasons discussed in Section 3. These latter tests are under way and are contemplated for reporting in a future paper.

In summary, the systematic character of the experimental results, combined with the limited capabilities of the used equipment, appear to confirm the hypothesis of new forms of hydrogen and oxygen with magnecular structure capable of producing an industrially significant increase in voltage, power and efficiency of fuel cells. Independent measurements are here solicited for the finalization of these issues.

Additional tests were conducted with MagneH produced from MagneGas as indicated in the preceding section.

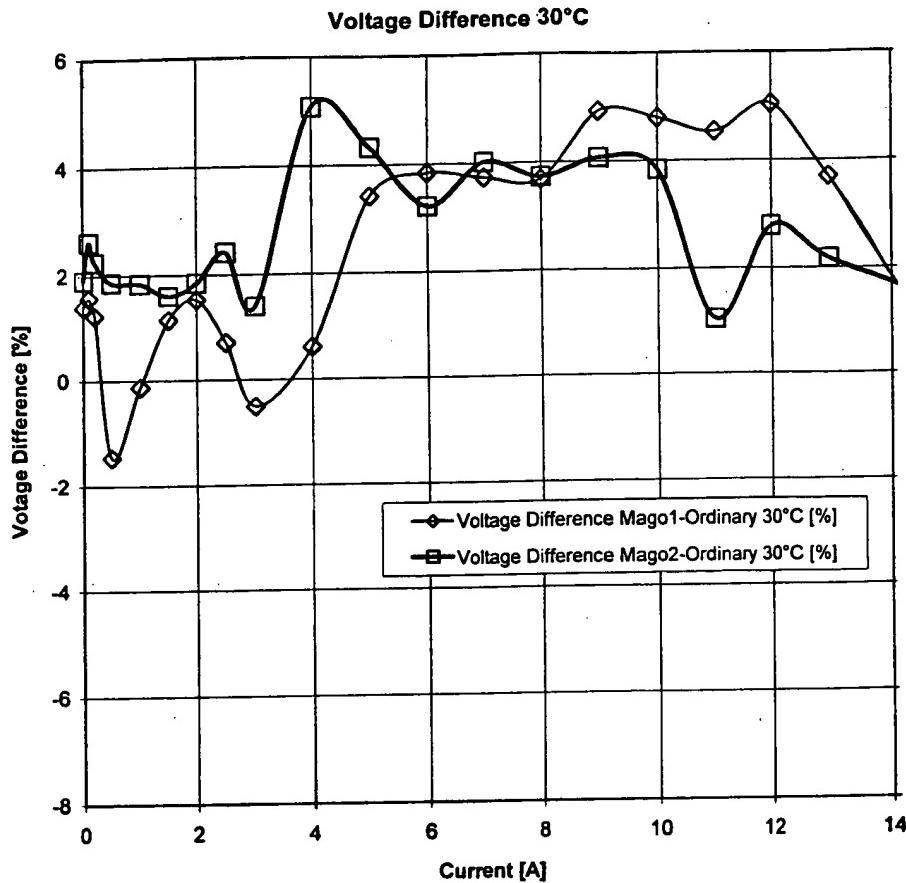


Fig. 11. A schematic view of the voltage increase in a test fuel cell operated with ordinary pure hydrogen and the two samples of MagneO produced by rudimentary equipment.

MagneGas was first produced by using antifreeze waste as liquid feedstock. The combustible gas was then passed through 5 Armstrong zeolite filters, which essentially consist of a microporous molecular sieve selecting a gas via the so-called “molecular sieving,” or molecular size exclusion. The filtered gas was then subjected to the following three measurements:

- (1) This type of MagneH was first subjected to analytic measurements by a laboratory via Gas Chromatography (CG) and independent tests for confirmation were conducted via Fourier Transform Infrared Spectroscopy (FTIS). All measurements were normalized, air contamination was removed, and the lower detection limit was identified as being 0.01%. The results are reported in Fig. 14. As one can see, these measurements indicate that this particular type of MagneH is composed of 99.2% hydrogen and 0.78% methane, while no carbon monoxide was detected.

- (2) The average specific weight of this type of MagneH was measured by two independent laboratories as being 15.06 a.m.u., while conventional pure hydrogen has the specific weight of 2.016 a.m.u., thus implying a 7.47 fold increase of the specific weight of conventional hydrogen.
- (3) The same type of MagneH used in the preceding tests was submitted to CG-MS scans via the use of a HP GC 5890 and a HP MS 5972 with operating conditions specifically set for the detection of magnecules (Section 5 and Ref. [5]). The results of these third tests are reproduced in Fig. 15. As one can see, by keeping in mind the results of GC-FTIS of Fig. 14, the GC-MS measurements should have shown only two peaks, that for hydrogen H₂ at about 2 a.m.u., and that for methane CH₄ at about 16 a.m.u. On the contrary, these GC-MS tests confirm the existence of a large peak at about 2 a.m.u. evidently representing hydrogen, but do not show any peak at 16 a.m.u. proportional to the 0.78%

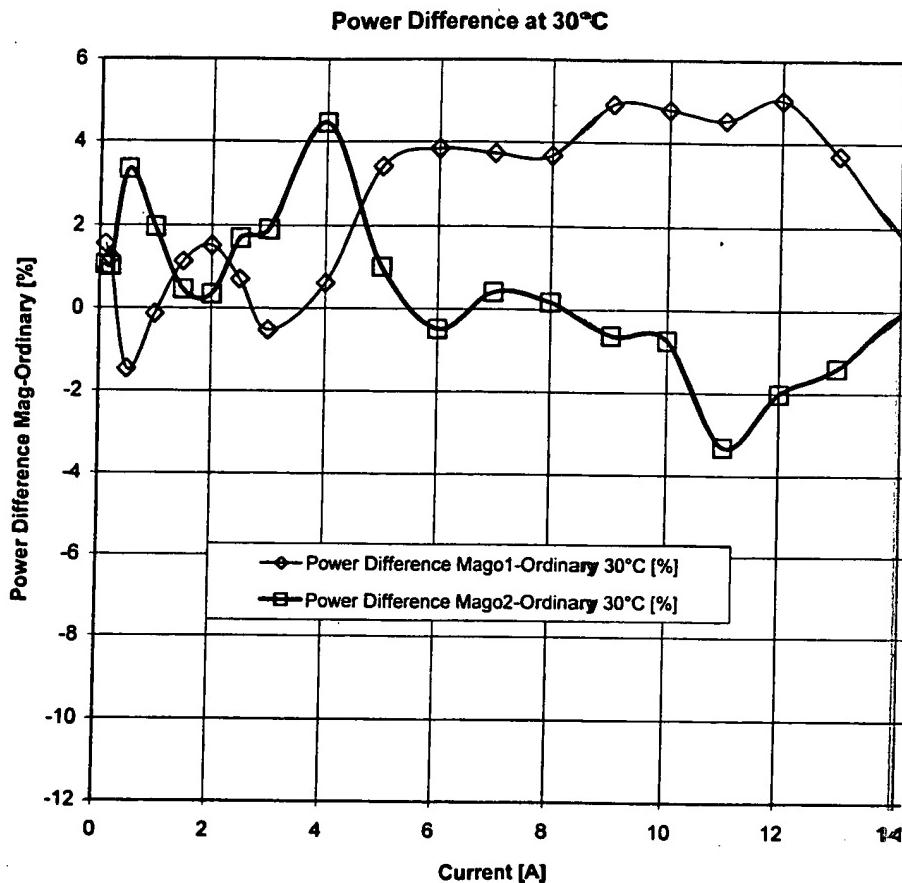
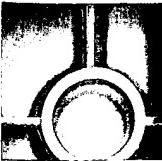


Fig. 12. A schematic view of the power increase in a test fuel cell operated as in Fig. 11 confirming the results of the latter.

of methane, and exhibit instead the presence of a considerable number of additional peaks in macroscopic percentages all the way to 18 a.m.u. This GC-MS scan establishes the existence beyond credible doubt of a magnecular structure in the type of MagneH here studied. Note, in particular, the existence of well identified peaks in macroscopic percentage with atomic weight of 3, 4, 5, 6, 7, 8 and higher values which peaks, for the gas under consideration here, can only be explained as magnecules composed of individual H atoms as well as H molecules in increasing numbers.

The above measurements (1), (2) and (3) confirm the capability to produce hydrogen, oxygen and other gases with a multiple value of their standard specific weight, and consequential increased energy content.

9. Conclusions

Despite the known uneasiness created by novelty, the rather vast experimental evidence, only partially reproduced

in this paper to avoid a prohibitive length, supports the following results:

- (1) The *existence in nature of a new chemical species whose bonding force is not of valence type* (from the absence of infrared signature and various other evidences as in Figs. 6 and 7), which has been interpreted by this author as being due to the only fields available in a molecular structure, the electric and magnetic fields, and called *electromagnecules* in general, the name *Santilli magnecules* being used to denote the dominance of magnetic over electric effects (Section 2). Other researchers may prefer different nomenclatures and search for esoteric fields other than the electric and magnetic fields, with the understanding that the *non-valence novelty* of the new species is outside scientific debate.
- (2) The *existence of a form of hydrogen with about seven times the atomic weight of molecular hydrogen which eliminates the need for liquefaction in automotive use, while having a power output essentially similar to that of gasoline, and being cost competitive with respect to*

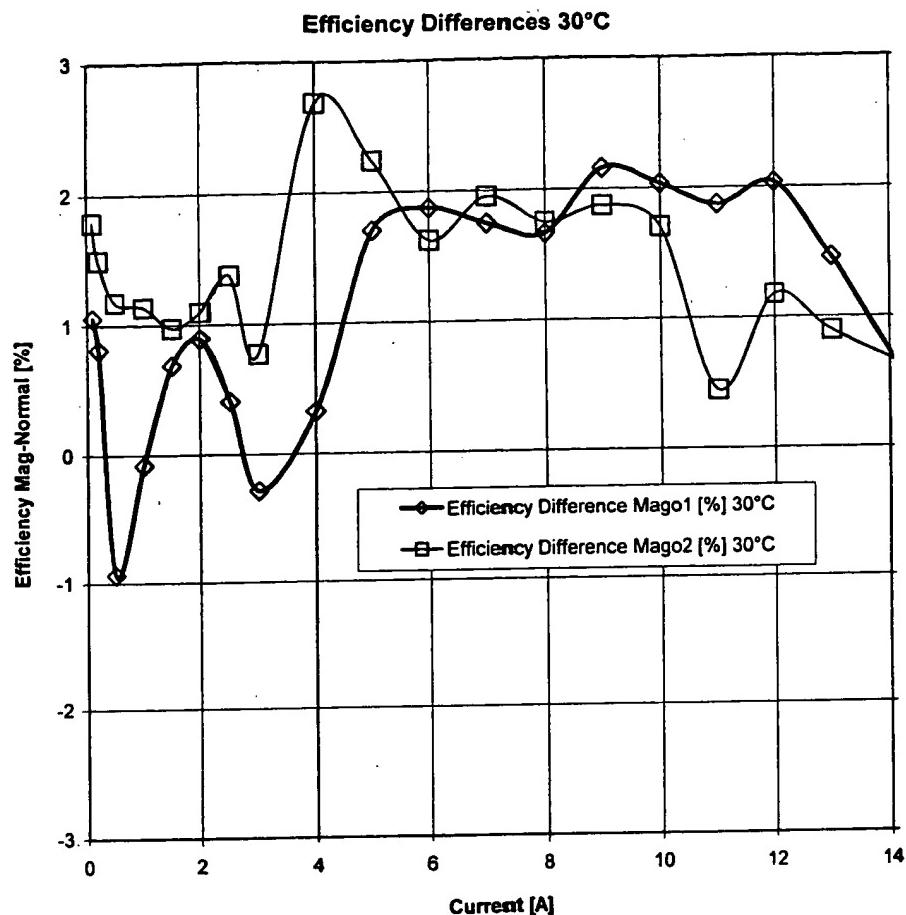


Fig. 13. A schematic view of the efficiency increase in a test fuel cell operated as in Fig. 11, which provide additional confirmation of the latter results.

fossil fuel when produced in large scale. This is the new species of hydrogen, called by this author MagneH™ (international patents pending) which is derived via filtering, cryogenic separation or other means from the new combustible fuel called *Santilli MagneGas*™ (international patents pending). The latter gas is produced via DC electric arcs between carbon-base consumable electrodes submerged within a hydrogen rich liquid feedstock, such as fresh or salt water, anti-freeze or oil waste, city or farm sewage, crude oil, etc.

- (3) The industrial capability of turning conventional hydrogen and oxygen into new species with bigger atomic weight and energy content for use in fuel cells with increased voltage, power and efficiency.
- (4) The existence of new forms of liquid hydrogen and oxygen for rocket propulsion with increased thrust, and consequential increased payload or decreased boosters' weight with the same payload.

(5) The experimental evidence of dramatic departures from quantum chemistry in support of the covering hadronic chemistry [5].

Evidently, these studies are in their infancy and much remains to be done, both scientifically and industrially. Among the existing intriguing open problems we mention:

- (A) The identification of new analytic equipment specifically conceived for the detection of magnecules. In fact, researchers in the field know well the dramatic insufficiency for tests on magnecular substances of currently available analytic equipment specifically conceived for molecular substances.
- (B) The identification of the possible frequency at which magnecules may have an infrared signature. For instance, the detection of methane in the MagneH tests of Fig. 14 has a mere indicative value, rather

Component	Gas
Hydrogen	99.2
Carbon monoxide	None detected
Carbon dioxide	None detected
Methane	0.78
Ethane	None detected
Ethene (ethylene)	None detected
Ethyne (acetylene)	None detected

Fig. 14. A summary chart of the analytic measurements via GC and, independently, via FTIS on the particular type of MagneH produced via zeolite filtering of MagneGas originating from ordinary tap water. Note the detection of 99.2% H₂, 0.78% of methane and no measurable CO.

than being an actual experimental fact. In any case, the detection of methane is not confirmed by at least one second independent test to achieve final scientific character. Also, a peak at 16 a.m.u. which is necessary in the GC-MS scans of Fig. 15 to confirm the presence of methane (CH₄), is missing. Finally, the original MagneGas is created in the 10,000°F of electric arcs at which temperature no methane can survive. In view of the above, a more plausible possibility is that the “methane” detected by the analyses of Fig. 14 is, in reality, the infrared signature of a magnecule.

- (C) The study of the liquefaction of MagneGases on a comparative basis with the liquefaction of the same gases with conventional molecular structure. This study is recommended particularly for rocket propulsion, due to the expected new species of *liquid magnecules* [5], the liquefaction itself at a temperature bigger than the conventional ones, the increase in trust and the reduction in liquefaction costs.

- (D) The study of the possible storage of energy in inert gases via the mechanism of internal magnetic polarization and resulting new molecular bonds illustrated in Figs. 5 and 8. In fact there exist patents as well as reported test engines operating on inert gases which are generally dismissed by academia because of the believed “inert” character of these cases. Perhaps, a more open mind is recommendable for truly basic advances.
- (E) The study of nonlinear deviations from the perfect gas law and the Avogadro number which are inherent in magnecular clustering since they can break down into fragments due to collision and then have different recombinations, resulting in a population with generally varying number of constituents, while keeping constant statistical averages.

Needless to say, the author solicits the independent verification of all results presented in this paper without which no real scientific advance is possible.

In closing with a personal note, the author dedicates this paper to the memory of *Amedeo Avogadro*, who was born in Turin, Italy, in 1776 and died there in 1856. The author conducted his graduate studies in theoretical physics at the *University of Turin*, and had the privilege of holding the chair of nuclear physics at the *A. Avogadro Technical Institute* in Turin, Italy, from 1965 to 1967. In this way, the author had access to historical records which gave him the opportunity of studying Avogadro’s original contributions, and some of the comments of the time.

As well known to historians, the constancy of Avogadro’s number was strongly opposed by scientists of his time, and became scientifically established as a pillar of contemporary chemistry only with the work by another Italian physicist, *Stanislao Cannizzaro* in 1858, unfortunately after Avogadro’s departure.

The perception by this author in studying these historical documents has been the emergence of Amedeo Avogadro as a towering scientific mind, not only because of his capability to be dramatically ahead of the science of his time, but also for the scientific balance and open mind solely dedicated to the pursuit of new scientific knowledge, which is the true essence of research. The new findings tentatively presented in this paper are dedicated to Amedeo Avogadro in memory of his teaching and example.

Acknowledgements

The author would like to thank Professors A.K. Aringazim, J. Dunning-Davies, J.V. Kadeisvili and several other colleagues and technicians for generous assistance in the completion of this paper. Particular thanks are due to the referees of the *International Journal of Hydrogen Energy* for simply invaluable critical comments.

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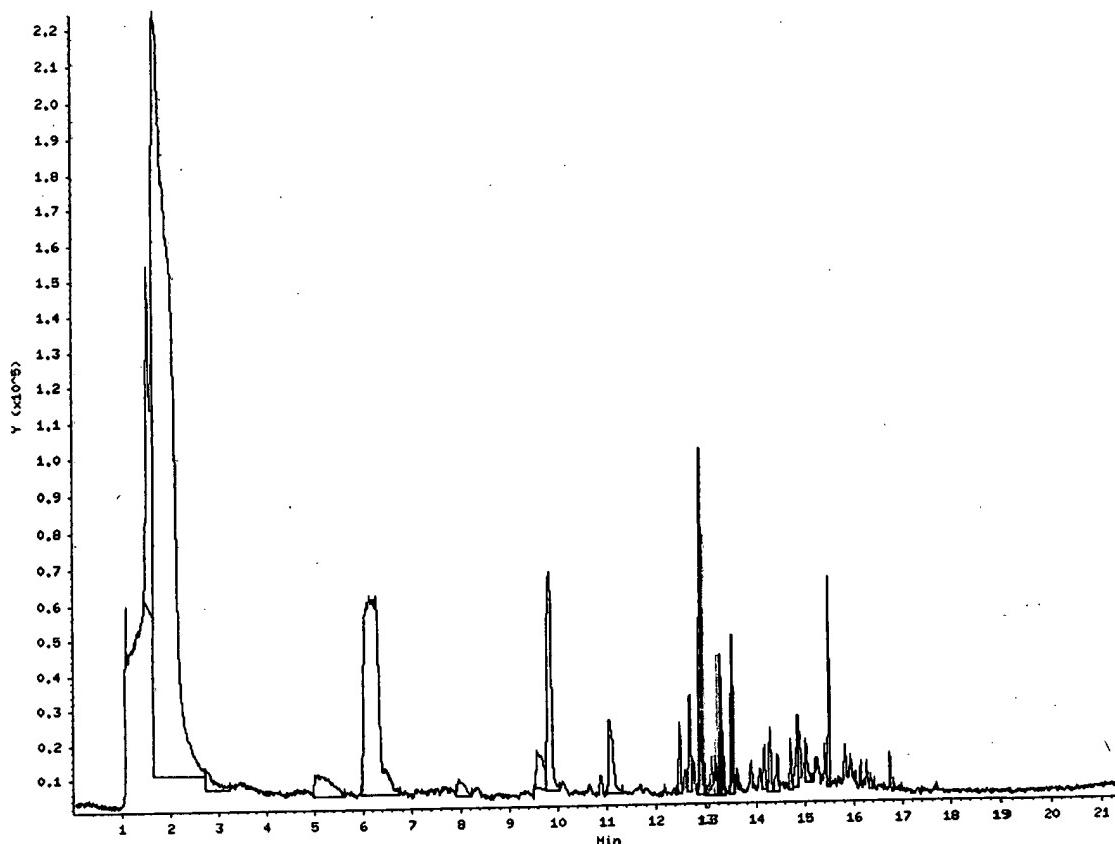


Fig. 15. A reproduction of one of the GC-MS scans of the same type of MagneH used in the tests of Fig. 14. Note the confirmation of the dominant existence of hydrogen at about 2 a.m.u., and the presence of new species which do not exist in the GC and FTIS tests of Fig. 14, thus establishing the existence of a new non-valence chemical species. Particularly significant are macroscopic peaks (here intended as peaks definitely outside the background) at 3, 5, 6, 8, and 10 a.m.u. which, for this particular type of gas, can only be interpreted as clusters of hydrogen atoms and molecules due to the absence of other elements in that range of atomic weight. These measurements establish beyond reasonable scientific doubt the industrial production of MagneH, MagneO and other magnetically polarized gases whose atomic weight, and consequential energy content are a multiple of those for conventional molecular values.

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**ADSORPTION RESEARCH INC.**6175-D Shamrock Court
Dublin, OH 43016Ph.: 614-798-9090
Fax: 614-798-9091**FAX MESSAGE**

To: Dr. Ruggero M. Santilli & Kenneth H. Heffner
USMagneGas, Inc.

Fax: 727-507-8261 / IBR: 727-934-9275

From: Kent Knaebel

Date: June 15, 2002

Subject: Separation and Molecular Weight Measurements of MagneGas™ and MagneHydrogen™

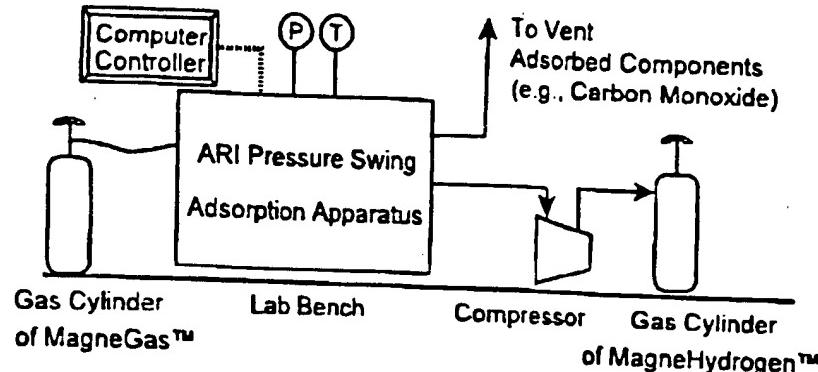
Dear Ruggero and Ken:

First, I will explain briefly our separation process, then I will explain how we measured molecular weights. To supplement the latter description, a data & calculation sheet is attached.

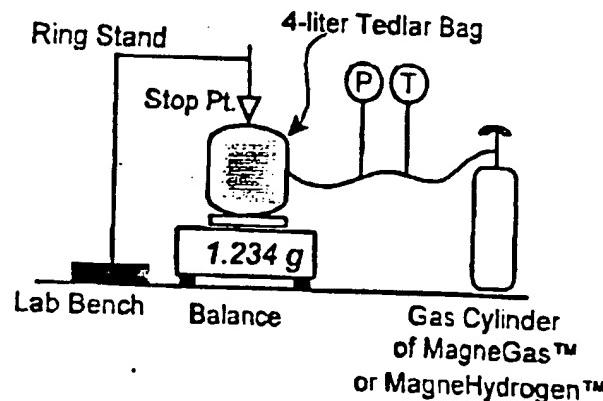
ARI conducted two separation trials using two different approaches to perform the separation. The first trial used a reduced copper catalyst bonded to an alumina substrate for removing carbon monoxide from the "MagneGas™" fuel sample. The premise was that the copper would exhibit attraction for the pi-bonds of the carbon monoxide. Unfortunately, this approach was not effective.

The second test employed 5A zeolite, a microporous molecular sieve. The premise was that a separation could be effected by molecular dimensions, exploiting the 'molecular sieving' effect. That is, it employs size exclusion, in addition to van der Waals forces. In subsequent off-line analyses, that test was shown to produce superior product, i.e., practically free of carbon monoxide. The third test employed 13X zeolite. The results of analyses from that test, however, are not known to ARI.

A semi-continuous, semi-automated separation was performed at ambient temperature employing a pressure swing adsorption (PSA) cycle using 5A zeolite to separate the gas components, removing the free carbon monoxide portion of the MagneGas™ sample, yielding MagneHydrogen™. Both gases were subsequently tested to determine their average molecular weights. The schematic diagram below shows the general features of the apparatus.



Concerning the measurements of molecular weight you requested, we conducted the measurements in a calibrated volume, into which a measured mass of gas was admitted. By determining the mass per volume, and applying the ideal gas law, we were able to estimate the molecular weight. A sketch follows.



Generally, the measurements were accurate within 1% error, while the difference between the average values was about 3.5%. Therefore, we consider the difference to be real and not an artifact of measurement discrepancies. As mentioned earlier, a copy of the spreadsheet containing the data and calculations is attached.

Sincerely yours,

Kent S. Knaebel

MagneHydrogen™

(CO-Free)

0.004970517

V (m³) =P_{room} (psia)T_{room} (°C)

Pa

K

MW_{air} (g/mol or amu/molecule)

29

$$M_{prod} = (m \cdot R \cdot T) / (V \cdot P) + M_{air}$$

$$M_{prod} (\text{g/mol or amu/molecule}) = 15.05958998$$

MagneGas™

(Approx. 4.2% CO)

0.004970517

V (m³) =P_{room} (psia)T_{room} (°C)

Pa

K

MW_{air} (g/mol or amu/molecule)

29

$$M_{prod} = (m \cdot R \cdot T) / (V \cdot P) + M_{air}$$

$$M_{prod} (\text{g/mol or amu/molecule}) = 15.05958998$$

Trial	Mass Change (g)
1	-2.578
2	-2.633
3	-2.616
4	-2.599
5	-2.6065

$$\text{std} = 0.023530123$$

$$\text{error\%} = -0.902747843$$

$$M_{reed} = (m \cdot R \cdot T) / (V \cdot P) + M_{air}$$

$$M_{reed} (\text{g/mol or amu/molecule}) = 15.5953946$$

CALCULATIONS

				DATA	
				Trial	Mass Change (g)
Hydrogen				1	-5.283
P _{room} (psia)	14.17	97698.70669	Pa	2	-5.277
T _{room} (°C)	25.8	298.95	K	3	-5.26
MW _{air} (g/mol or amu/molecule)	29			4	-5.312
MW _{H₂} (g/mol or amu/molecule)	2.01594			5	-5.158
V=(m*R*T)/(P*(M _{H₂} -M _{air}))				m=	-5.258
V (m ³) =				Std=	0.058961852
				error% =	-1.121374136
He					
Helium					
P _{room} (psia)	14.24	98181.33968	Pa		
T _{room} (°C)	26.2	299.35	K		
MW _{air} (g/mol or amu/molecule)				Trial	Mass Change (g)
MW _{He} (g/mol or amu/molecule)	29			1	-4.904
V=(m*R*T)/(P*(M _{He} -M _{air}))	4.0026			2	4.948
V (m ³) =				3	4.923
				4	-4.884
				5	-4.91475
				std=	0.027293162
				error% =	-0.555331635

RESULTS

In the following equations, f=Feed=MagneGas™, co=CO, i=arbitrary other component, p=Product=MagneHydrogen™:
The "feed" and "product" designations refer to the ARI Pressure Swing Adsorption Separation Apparatus, which performed the separation.

$$MW_f = X_{co} \cdot MW_{co} + \text{SUM } (X_i \cdot MW_i) = 15.60 \text{ (g/mol or amu/molecule)}$$

$$MW_p = \text{SUM } (X_i \cdot MW_i) / (1 - X_{co}) = 15.06 \text{ (g/mol or amu/molecule)}$$

Using that equation yields a feed mole fraction of CO, $X_{co} = 0.0417$.

Again, this is just an estimate, and it relies on the assumption that the PSA unit quantitatively removed CO from the mixture.
In addition, the molecular weight measurement may be off by about 1%, too.
That potential error is not large enough to explain the difference of the numbers (considering multiple trials were run).

Table 1: Molecular Weight
(Determined with Constant Volume System Calibrated with Hydrogen and Helium)

Gas	Molecular Weight (g/mol or amu/molecule)
MagneGas™ [Feed]	15.60
MagneHydrogen™ [Product]	15.06
Ordinary Hydrogen [for comparison]	2.016



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SPL3464B
3/19/02

SPECTRALAB TEST REPORT FOR US MAGNEGAS

REQUESTED BY: Leon Toups, President, US MagneGas

SUBJECT: Analysis of MagneGas Processed to Remove Carbon Monoxide

SUBMITTED SAMPLES:

Samples A and B were submitted stored in low pressure cylinders at about 15 psig.

SUMMARY OF RESULTS:

The chemical composition of the submitted gas samples were determined by gas chromatography (GC) and Fourier-transform infra-red spectroscopy (FTIR). These analyses and those for prior gas samples are presented in the Tables of Results.

Based on a conventional chemical analysis utilizing gas chromatography, gas sample B was found to contain primarily hydrogen (55.2 %) and carbon monoxide (48.6 %) in similar amounts. Minor components included air (1.9 %), carbon dioxide (0.2 %), and a distribution of hydrocarbons composed primarily of methane (1.3 %), ethyne (0.03 %), ethene (0.05 %) and ethane (0.01 %). The amount of air was not included in the composition of the gas. The sample composition of sample B is similar to previous sample analyses reported in SPL3331 and SPL3346 except that acetylene was much lower in sample B than in previous samples. Sample A on the other hand, was found to contain virtually all hydrogen (99.2 %) with only small amounts of methane (0.8 %) and air (3.5 %) present. Again, the amount of air was not included in the composition of the gas. No carbon monoxide or carbon dioxide was detected. Nor were any higher hydrocarbons detected. FTIR analysis results confirmed the GC results for samples A and B.

SPL3464B

PROCEDURES/RESULTS:**Gas Chromatography (GC)**

GC analysis was performed by injecting the sample within a 0.86 ml sample loop using an HP-5880A GC with a thermal conductivity detector (TCD). The separation of the components was obtained using a 15 ft long, 1/8 in od column packed with 80/100 mesh Porapak S and a 12 ft long, 1/8 in od column packed with 60/80 mesh molecular sieve 5A. The columns were placed in series, using switching valves, to separate hydrogen, oxygen, nitrogen, methane and carbon monoxide, while the remaining components, carbon dioxide, ethene, ethyne, ethane and higher molecular weight hydrocarbons, were analyzed with the Porapak S column connected directly to the TCD. Temperature programming was used to provide an efficient analytical method. Two separate analyses were performed. Known gas mixtures were used to calibrate the TCD.

Representative chromatograms are presented in Figures 1 and 2. Results are presented in Table I.

The results of the analysis of sample B was similar to previous analyses of samples produced from anti-freeze mixtures of either ethylene glycol or propylene glycol and water. The removal of all components except hydrogen from sample B was largely successful. Only a small amount of methane and air remained after purification.

Fourier Transform Infrared Spectroscopy (FTIR):

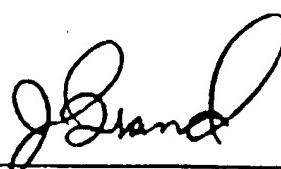
The test was conducted per Spectralab test procedure STP 135. FTIR spectra were obtained using a Perkin Elmer model 1650 FTIR with Spectrum for Windows software. The submitted gas sample and calibration standards were each analyzed in a 10cm gas cell at atmospheric pressure. The background run for each standard was obtained on an evacuated cell. Component compositions were calculated from the absorbance values at 3310 cm^{-1} for ethyne (acetylene), 3014 cm^{-1} for methane, 2360 cm^{-1} for carbon dioxide, 2171 for carbon monoxide and 949 cm^{-1} for ethane (ethylene). The calibration standard for acetylene (1%), carbon dioxide (1%), methane (1%) and ethylene (1%) was obtained from Supelco (Scott Specialty Gas #0104216). The calibration standard for carbon monoxide (50%) and hydrogen (50%) was supplied by Matheson (lot #105-06-03669). Representative sample spectra are presented in Figures 3 and 4.

Results are presented in Table II with previous results of analyses conducted on SPL3331 and 3446.

APPROVALS:

MM

Michael J. Manka, Ph. D.



Jack Brand, Lab Director

SPL3464B

Table I
GC Analyses
Conventional Chemical Composition¹

Component	Gas A	Gas B	Prior results SPL3331	Prior results SPL3446
Hydrogen	99.2	55.8	50.0	53.4
Carbon monoxide	None detected ²	42.6	42.9	41.9
Carbon dioxide	None detected ²	0.17	0.7	2.5
Methane	0.78	1.25	2.4	1.0
Ethane	None detected ²	0.01	0.02	0.01
Ethene (ethylene)	None detected ²	0.08	0.3	0.2
Ethyne (acetylene)	None detected ²	0.03	3.9	0.9

¹ Results are normalized and exclude the amount of air present.

² The detection limit is <0.01 %.

Table II
FTIR Analyses
Conventional Chemical Composition

Component	Gas A	Gas B	Prior results SPL3331	Prior results SPL3446
Carbon monoxide	None detected*	45.5	44.6	42.8
Ethyne (acetylene)	None detected	0.05	4.5	1.2
Methane	0.8%	1.1	1.4	1.0
Carbon dioxide	0.01%	0.3	1.5	3.0
Ethene (ethylene)	None detected	0.08	0.6	0.3
Hydrogen (not measured)	Assumed balance	Assumed balance	Assumed balance	Assumed balance

* Detection limit ~ 0.1%.

Preprint of the Institute for Basic Research IBR-TC-034-01, of May 20, 2001,
revised March 15, 2003, revised August 10, 2003
submitted for publication

EXPERIMENTAL EVIDENCE ON A NEW HEAVY SPECIES OF HYDROGEN WITH SANTILLI MAGNECULAR STRUCTURE

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Abstract

In this note we present recent measurements indicating the apparent existence of a new species of hydrogen at the gaseous state with the specific weight of 15.06 a.m.u. while resulting to be composed of 99.2% Hydrogen that normally has specific weight of 2.016 a.m.u.; we make available the gas originally used for the production of said new species for independent re-runs of the measurements by interested colleagues; and we outline the most plausible theoretical interpretation of the new species available at this writing, that via the new chemical species of *Santilli magnecules* [1], whose formulation is solely based on the application to atoms of ordinary quantum electrodynamics without the rather fashionable assumption of new esoteric valence bonds having no clearly identified *attractive force* necessary for the bond. Alternative theoretical interpretations of the experimental data are encouraged, provided that they have equal plausibility and representational capability without experimentally unverified esoteric assumptions.

1. The Experimental Evidence on the New Species of Hydrogen. In this note we report an apparently new species of Hydrogen obtained by the Italian-American physicist Ruggero Maria Santilli via molecular sieving separation from a combustible gas produced via an underwater DC electric arc between Carbon-base electrodes. Quantum chemistry predicts that such a combustible gas is composed of 50% Hydrogen contained in a *mixture* (rather than a valence bond) with other Carbon-base gases, thus permitting separation via molecular filtering, pressure swing adsorption, and similar methods.

The new species of Hydrogen was separated at Adsorption Research Laboratory of Dublin, Ohio, by passing said combustible gas various times through a 0.5 nm zeolite, that, as well known, separates gases via a process called "molecular sieving," or molecular size exclusion. Santilli then obtained the following measurements on the new species of Hydrogen:

1) Following the separation of the new species, Adsorption Research Laboratory conducted in February 2001 measurements of specific weighty, and released a signed statement according to which the new species has the specific weight of 15.06 atomic mass units (a.m.u.), namely, 7.47 times the specific weight of conventional Hydrogen that has the specific weight of 2.016 a.m.u. (Figure 1).

2) In March 2001 SpectraLab of Largo, Florida, conducted analyses on the chemical composition of the same species of Hydrogen tested by Adsorption Research Laboratory via the use of Fourier Transform Infra-Red Spectroscopy (FTIRS) and other equipment. All measurements were normalized, air contamination was removed, and the lower detection limit was identified as being 0.01%. SpectraLab then released a signed statement according to which said species is composed of 99.2% Hydrogen, the rest being apparently given by 0.78% methane and traces of other substances (Figure 2).

3) In April 2001, Air Toxic Laboratory of Folsom, California, subjected the same sample of Hydrogen used in the preceding two tests to Gas Chromatographic Mass Spectrometric (GC-MS) scans via the use of a HP GC model number 5890 and a HP MS model number 5972. Air Toxic Laboratory then released a signed statement with computer print-outs of the scans showing the species to be composed of a dominant peak at about 2 a.m.u. representing Hydrogen, plus numerous additional peaks in macroscopic percentages that are unidentifiable by the computer search among known molecules (Figure 3).

The above analyses were repeated at different laboratories by confirming the indicated results. For instance, SpectraLab repeated the measurement of specific weight of the new species by confirming the value of 15.06 a.m.u. obtained by Adsorption Research Laboratory; the FTIRS tests done by Spectra Lab were repeated at Adsorption Research Laboratory by confirming the content of 99.2% Hydrogen; and the GC-MS scans of Air Toxic Laboratory were repeated by other laboratories confirming the presence of a major peak representing H_2 plus a series of unidentifiable peaks.

Santilli's new species of Hydrogen has an evident significance for the emerging new Hydrogen era, since the increased specific weight implies a corresponding reduction of storage volume, thus avoiding the expensive cryogenic liquefaction of Hydrogen currently needed to achieve sufficient range by the BMW, GC and other Hydrogen fueled cars; the underwater electric arc is notoriously much more efficient in the separation of water than electrolysis, thus implying a major reduction in Hydrogen cost; and the new species of Hydrogen is contained as a mixture with other gases, thus implying additional cost reductions compared to other methods of Hydrogen production based on the break-down of its valence bond, as it is the case for the reformation of fossil fuels.

In view of the above significance, the original combustible gas used in the production of the new species of Hydrogen is here made available on request to interested colleagues for the independent repetition of the separation of Hydrogen as well as the repetition of measurements 1), 2) and 3), under the sole condition of using the same equipment and procedures in view of difficulties in the detection of the new species outlined below.

2. The New Chemical Species of Santilli Magnecules. In view of the clear environmental significance of the new species of Hydrogen, it is essential to identify at least one plausible working hypothesis on its structure, since the latter is important for the optimization of production methods and further reduction of costs.

Since Hydrogen has only *one valence electron*, interpretations of the new Hydrogen species via valence bonds in any of their various forms are not plausible, besides having

no visible value due to the absence of a *numerical* interpretation of the data *without* the rather fashionable assumption of experimentally unverified, esoteric new forms of valence lacking a clearly identified *attractive force* as needed for the bond.

Therefore, Santilli's identification of the new species of Hydrogen has the far reaching scientific importance of mandating, apparently for the first time in chemistry, the search for *basically new bonds not based on valence*.

The second objective of this note is to report that, following a rather laborious search by the author, the most plausible hypothesis for the quantitative interpretation of the experimental data of Section 1 is given by the new chemical species of *Santilli magnecules* [1].

For the case of gases, magnecules can be defined as consisting of clusters of individual atoms (such as H, C, O, etc.), radicals (such as O-H, C-H, etc.), C-O in single valence bond, C=O in double valence bonds, and ordinary molecules (such as H₂, CO in triple valence bonds, H₂O, etc.), all bonded together by attractive forces among opposite magnetic polarities originating in toroidal polarizations of the orbitals of at least some of the peripheral atomic electrons when exposed to sufficiently strong (electric and) magnetic fields.

Stated in elementary language, natural distributions of electron orbitals in all space directions possess no well defined magnetic field. However, when the same electrons are caused to orbit within a toroid, quantum electrodynamics predicts the creation of a magnetic field with polarities North-South along the symmetry axis of the toroid. Santilli magnecules are merely given by two or more atoms with said polarization of their orbitals bonded together by opposing magnetic polarities North-South-North-South-etc. Their plausibility, also due to their solid foundations on established disciplines, is then beyond scientific doubt.

The clusters of the new species of magnecules are identifiable by suitably selected GC-MS (Figure 4) operated according to procedures indicated in the next section. A given MS peak with a given a.m.u. value constitutes a Santilli magnecule when it remains unidentified by the computer search among all known ordinary molecules and, when tested under InfraRed Detectors (IRD), said peak admits no IR signature other than those of its constituents at lower a.m.u. value (Figure 5). For brevity we cannot here reproduce the numerous additional measurements and experimental evidence provided in Ref. [1].

The absence of an IR signature, specifically, at the a.m.u. value of the peak (rather than at the smaller a.m.u. values of its constituents) is crucial for the detection of Santilli magnecules, since it establishes the lack of valence character of the bond in view of the generally large a.m.u. value (see again Figure 4) under which valence bonds with perfect spherical symmetry (as needed for no IR signature) are practically impossible.

The identification of the new species of magnecules finally requires the occurrence of physical conditions necessary for its creation. By taking into consideration the existing literature (see, e.g., refs. [3a,3b] and large number of papers quoted therein), A. K. Aringazin [3c] conducted an in depth study on the toroidal polarization of atomic orbitals (reviewed in Appendix 8A of Ref. [1]), and confirmed the need of very high values of electric and magnetic fields as predicted by quantum electrodynamics.

Along these fully established lines, Santilli created the new species of magnecules detected in the scans of Figures 4 and 5 by flowing a liquid through a submerged electric arc (U.S. Patents numbers 6,183,604 and 6,540,966, and other patents pending). The liquid molecules are decomposed by the arc, and then mostly ionized, resulting in the formation of a plasma at about 10,000° F. Since the magnetic field B of an electric arc (see Figure 6) is directly proportional to the DC current I and inversely proportional to the distance r , it is easy to see that at atomic distances of 10^{-8} cm from a DC arc with 10^3 A, orbitals are exposed to magnetic fields up to 10^{11} Gauss, thus being amply sufficient to deform conventional spherical distributions of the orbitals into toroidal forms (see [1] for details).

Moreover, calculations originally done by Santilli [1] and confirmed by M. G. Kucherenko and A. K. Aringazin [3] have established that the magnetic field of a toroidal polarized Hydrogen atom is 1,415 times bigger than the nuclear magnetic field. These results not only identified concretely the *attractive force* needed for the creation of a bond (identification absent in several models of esoteric valence bonds), but also identified its *numerical value*, thus increasing dramatically the plausibility of the new species of Santilli magnecules.

Needless to say, toroidal polarizations are, individually, highly unstable because they disappear immediately following the termination of the external field, in which case orbitals reacquire their natural spherical distributions. However, once two polarized atoms are bonded to each other via opposing magnetic polarities, the bond is indeed stable at ambient temperature and pressure, because rotations, vibrations and other motions due to temperature occur for the bonded couple as a whole. The same argument holds for bonds of more than two atoms, resulting in clusters conceptually illustrated in Figure 7.

It should be noted that the geometry of the DC electric arc is particularly suited for the new magnecular bond. As illustrated in Figure 6, said geometry is such to: achieve the needed toroidal polarization (illustrated in the figure with circles perpendicular to the local magnetic field line); naturally align polarized atoms next to each other with opposite magnetic polarities North-South-North-etc.; and force polarized atoms one against the other due to the magnetic field itself and other reasons (such as the Casimir effect).

From the presence of both electric and magnetic fields, Santilli called the new species "electromagnecules" [1] in order to distinguish it from the ordinary species of "molecules." In view of the dominance of magnetic over electric effects, the new species is now known as *Santilli magnecules*. Gases having a magnecular structure are called *MagneGases* and are now in industrial production and sale [1].

One should keep in mind the insistence in the *atomic* (rather than molecular) character of the polarizations here considered and related bonds [1]. As such, the new bonds apply irrespective of whether dealing with paramagnetic or diamagnetic molecules.

As an illustration, the Hydrogen molecule is known to be *diamagnetic*, thus being unable to acquire any appreciable *total* magnetic polarization. However, quantum electrodynamics establishes that individual *atoms* of a Hydrogen molecule can indeed acquire a toroidal polarization of their orbitals, thus permitting the bond at the *atomic* (rather than molecular) level.

A quantitative interpretation of the experimental data of Section 1 is then straightfor-

ward. By denoting with the symbol – conventional valence bonds and with the symbol \times the new magnecular bonds, all clusters of Figure 3 can be quantitative explained via cluster with structures of the type $H_3 = (H - H) \times H$, $H_4 = (H - H) \times (H - H)$, $H_5 = (H - H) \times (H - H) \times H$, etc. The species is then called *MagneHydrogen* and denoted with the new symbol MH.

At any rate, the measurements indicated in Section 1 provide strong experimental evidence in support of Santilli magnecules, precisely because conducted on Hydrogen. In fact, conventional valence bonds cannot possibly provide a credible explanation of the peaks detected at the a.m.u. values 3, 5, 6, 9, 10, 11, 12, etc. Moreover, the species was produced via a controlled molecular sieving with 0.5 nm openings. None of the latter species should, therefore, have been detected. The only plausible interpretation of the presence in a 0.5 nm zeolite of species so heavy is that the Hydrogen atoms and molecules are axially aligned along a common symmetry axis of magnetic polarization, thus have the capability of penetrating within said zeolite.

Note that the scans of Figure 3 confirm *the presence in magnecules of individual atoms without valence bonds*, since only this occurrence can explain the accretion from H_2 to H_3 , from H_4 to H_5 , etc. Broader experimental evidence of the presence of individual atoms in magnecules is provided in Ref. [1].

Note also that the species H_3 is often detected in GC-MS scans and appears to be created by the ionization process itself, rather than being present in the original substance. Santilli magnecules offer the new interpretation of H_3 as being composed of an H_2 molecule with a *magnetically* (rather than valence) bonded H atom. This new interpretation is compatible with the well established evidence that valance bonds occurs in *pairs* and not in triplets (see the analysis in Ref. [1], Section 8.4). At any rate, the geometry creating the species H_3 in the ionization process of GC-MS scans is essentially the same as that for the creation of Santilli magnecules (Figure 6).

The known existence of the species H_3 provides an evident support for the expectation of the heavier species H_4 , H_5 , etc., with the clarification that the creation of the latter species requires magnetic fields dramatically stronger than those of the GC-MS ionization process [2], precisely as done by Santilli in the creation of his magnecules.

The lack of detection of methane by the GC-MS scans while detected in 0.78% by the FTIRS tests constitutes yet another illustration of the novelty of the field. In fact, CH_4 cannot exist in the original gas because created at the 10,000° F of the electric arc. Also, methane could not have been adsorbed by the molecular sieving process due to insufficient intermolecular sizing. Assuming that, somehow, its passage escaped the analysts, the macroscopic presence of 0.78% methane should have been detected by the GC-MS, while the scan of Figure 3 reveals no appreciable peak at 16 a.m.u. Even assuming that all these diversified inconsistencies could be somehow bypassed via machinations to salvage valence bonds, the final resolution is provided by *the absence in the species of the IR signature belonging to the methane*.

Note finally that *Santilli magnecules are solely based on conventional quantum electrodynamics applied to conventional atomic structures, are fully compatible with conventional quantum mechanics, and require no assumption of esoteric and hypothetical bonds often*

without a clearly identified attractive force. As such, Santilli magnecule provide a plausible and quantitative interpretation of the measurements of Section 1. Alternative theoretical interpretations are here solicited, provided that they have the same plausibility, permits an equally quantitative representation and, above all, are not based on hypothetical and unverified new versions of the valence without a clearly identified *attractive force* necessary for a credible interpretation of the bond.

3. Analytic Difficulties in Detecting Magnecules via Molecular Methods. A word of caution should be voiced for colleagues interested in their independent detection of Santilli magnecules, because the currently available equipment has been developed for the detection of the *different* species of molecules. These difficulties are identified in detail in Ref. [1]. To render this note self-sufficient and by asking leniency to readers since the author is also a theoretical physicist, the difficulties can be summarized as follows.

A **first problem** is due to the fact that different molecules have clearly different features characterized by different peaks in the MS or IR scans. Therefore, one single detection (for instance, one via a GC-MS) is generally sufficient for molecular identifications. While fully valid for molecules, this procedure is no longer acceptable for Santilli magnecules whose identification requires the use of *at least two different detections*.

For instance, the detection in the FTIRS of a peak representing methane is no longer sufficient for a scientific identification, and at least one second identification is necessary to avoid "experimental beliefs." As indicated earlier, methane detected in the FTIRS scans of Figure 2 was not confirmed in the GC-MS scans of Figure 3. In any case, methane cannot be present in 0.5 nm zeolites and cannot survive at the 10,000° F of the plasma creating the gas. Similarly, the detection in a GC-MS alone of a peak at 4 a.m.u. is no longer sufficient for a scientific identification of the peak with Helium, because, until disproved, the possibility that the 4 a.m.u. peak could be the magnecule $H_4 = (H - H) \times (H - H)$ cannot be dismissed lightly, e.g., in forensic procedures.

The best instrument recommended for the detection of magnecules (as well as for conventional molecules) in gases is a GC-MS necessarily equipped with IRD [1]. The GC-MS/IRD first permits the identification of a peak in the mass scans, and then permits the study of the specific peak considered under the IR scan, resulting in a dual measurement of the same peak. For instance, analysts Louis A. Dee and Norman Wade of NTS laboratories at the McClellan Air Force Base in Sacramento, California, selected for the scans of Figures 4 and 5 an HP GC model 5890, an HP MS model 5972, and an HP IRD model 5965.

The use of two separate instruments, that is, the GC-MS and, separately, the IRD for the test of the same gas is strongly discouraged, because not leading to final analytic results, again, because the peaks identified in the GC-MS are not generally kept in the IRD when separately used, resulting in two generally different analytic results whose reconciliation is reduced to theoretical conjectures one way or the other.

The presence in the GC-MS of the IRD is truly crucial for the detection of magnecules. This is due to the appearance of numerous peaks in the GC-MS that, according to long standing practice by chemists, may be subjected to an interpretation via one given molecule or another. The main function of the IRD is to show that *a magnecular peak has*

no IR signature at its atomic weight (see Figure 5), thus excluding the possibility that such a peak can represent a molecule due to its generally large atomic weight for which no perfect spherical symmetry is credible.

Needless to say, magnecules do have IR signatures for the *constituents* of the considered peak at much smaller a.m.u. values. For instance, the MS peak of Figure 4 at 257 a.m.u. may have a clear IR signature for CO , another for CO_2 , another for H_2O , another for C-H, etc., all signatures belonging to molecules and/or radicals actually existing in the peak considered. The point is that *these signatures do not occur at the 257 a.m.u. of the considered MS peak and, consequently, they cannot possibly identify the nature of that peak*. When the IRD is attached to the GC-MS, its setting at 247 a.m.u. gives the IR signature of that peak and not of its constituents.

A second problem in the detection of magnecules is that contemporary analytic equipment are designed for fast and efficient commercial detections, for which scope they generally have strong ionization or other detection processes. The full validity of these instruments for the detection of molecules is, again, out of question here, because valence bonds are very strong and the ionization energy is known to be below the valence fragmentation value. This second problem originates when these molecular instruments are used to attempt the detection of magnecules, because their bond is weaker than the molecular one, and the ionization energy of the instruments can be bigger than the fragmentation energy, in which case the instruments produce beautiful results, although solely applicable to the *fragments*, and not to the species itself.

In the absence of an analytic instrument specifically designed to detect molecules and magnecules, the only recommended solution is the selection of the detection process and its setting admitting the smallest possible fragmentation. For instance, to reach the scans of Figures 4 and 5, analysts Louis A. Dee and Norman Wade operated their GC-MS/IRD at the lowest ionization voltage, and the same approach was used by the analysts of Air Toxic Laboratory to reach the scan of Figure 3. It is an instructive exercise for interested analysts to personally eyewitness the fact that GC-MS scans of gases with magnecular structure conducted at minimal and maximal ionization voltages produce substantially different mass spectra.

Another illustration of the difficulties in detecting magnecules with molecular instruments is given by the fact that flame ionization generally detects no magnecular structure at all, because the temperature of the ionization method can be bigger than the Curie temperature of the species, under which temperature all magnetic polarizations disappears according to a well established physical law.

These are the reasons why, to reach the scans of Figures 4 and 5, analysts Louis A. Dee and Norman Wade used their GC-MS/IRD at the lowest possible operating temperature. In addition, they even cooled cryogenically the feeding line to assure the lack of alteration of the species due to ambient temperature.

A third problem is caused by the use of micrometric feeding lines whose applicability to conventional molecular gases is, again, out of question, while the scientific detection of magnecules require the use of the largest possible feeding line, e.g., those with 0.5 mm diameter. Being originally sceptical on this issue, the author has personally eyewitnessed

the fact that a GC-MS with a feeding line of 0.1 mm provided no scan at all, while the sole change of the feeding line into one of 0.53 mm diameter yielded a large mass spectrum.

The only interpretation the author can provide on this occurrence is that reported by Santilli [1], namely, that feeding lines with very small sectional areas are clogged up with magnecules attached to the walls of the lines because of the well known magnetic induction, thus resulting in the possible occlusion of the line itself. In conclusion, the use of very small feeding lines generally prevents the species to be tested from even entering into the instrument, let alone conducting any measurement of any scientific value.

A fourth problem is given by the elusion time that, in contemporary commercial instruments, is generally reduced to a minimum to increase productivity. Again, the use of GC-MS with small elusion times is fully acceptable for the detection of molecules, because their separation is assured by the high ionization voltage and other procedures. However, the use of short elusion times generally prevents the detection of magnecules. In fact, to reach the scan of Figures 4 and 5, analysts Louis A. Dee and Norman Wade set their GC-MS/IRD at the maximal allowed elusion time of 21 minutes. As reported by Santilli in Ref. [1], the same gas tested with the same instrument but operated at another laboratory for less than one minute elusion time yielded the grouping of the various peaks of Figure 4 into one single peak (see Figures 8.13 and 8.14, pages 346-347, Ref. [1]), in which case no scientific identification of the structure of the species is possible.

Yet other problems in the identification of magnecules are given by protracted use of procedures fully established for the detection of molecules. For instance, analysts customarily check the blank of the instrument before and after the scans, to verify that the instrument is properly working. Following the removal of the gas from the instrument, in the event the blank shows the detection of anomalous peaks, the entire analysis is usually rejected on grounds that the instrument failed to operate properly.

The validity of this procedure for the detection of molecules is, again, out of question. However, for the case of magnecules the occurrence is exactly the opposite as that for molecules. In the event there is no anomalous peak in the blank following the removal of the gas, the analysis is generally defective and should be discarded, e.g., because the species was too large for the selected feeding line and, therefore, the only species that entered into the instrument was that of the molecular constituents, or the magnecular structure was destroyed by the detection process. In reality, the presence of anomalous peaks in the blank following the removal of the gas is another direct experimental evidence of the magnetic polarization of the species due to its adhesion to the interior of the instrument via magnetic induction, thus implying the presence of residual gas in the instrument following its removal.

The internal adhesion of gases with magnecular structures is actually such that, following their use to detect magnecules, instruments generally fail to provide routine detections of ordinary molecules, unless they are flushed with an inert gas at high temperature until they regain the standard blank in the absence of detections.

The above and other analytic difficulties illustrate the reason why Santilli magnecules escaped identification throughout the 20-th century. The same difficulties illustrate the need of extreme caution in venturing a conventional molecular interpretations for any

species in which the new magnecular structure is suspected.

The reader should be aware that, in addition to the original, rather vast experimental evidence on the existence of Santilli magnecules presented in monograph [1], and the new experimental evidence presented in this note, rather vast additional evidence is under finalization for presentation in subsequent papers. Admittedly, the theoretical interpretation of the new chemical species as originating from the toroidal polarization of orbitals is only the most plausible at this writing and, as such, must be subjected to scientific scrutiny.

The important point established by the experimental evdience here considered is the existing in nature of *new bonds not due to valence*, a result that is *per se* a momentous contribution by Santilli to chemist, besides the achievement of a numerically exact representation of experimental data on conventional molecules that preceding the discovery of magnecules [1].

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- [3] M.G. Kucherenko and A.K. Aringazin, *Hadronic Journal* **21**, 895 (1998).

**ADSORPTION RESEARCH INC.**

6175-D Shamrock Court
Dublin, OH 43016

Gas	Molecular Weight (g/mol or amu/molecule)
MagneGas™ [Feed]	15.60
MagneHydrogen™ [Product]	15.06
Ordinary Hydrogen [for comparison]	2.016

FIGURE 1: A reproduction of the main results of the signed statement released by Adsorption Research Laboratory of Dublin, Ohio, on the measurement of the specific weight of: 1) the original gaseous feedstock (called "MagneGas") with specific weight of 15.60 a.m.u.; 2) the new species of Hydrogen obtained via molecular sieving on 0.5 nm zeolites (called "MagneHydrogen") with specific weight 14.06, and 3) conventional Hydrogen H_2 with specific weight 2.016 a.m.u. According to these measurements, independently repeated and confirmed by other laboratories, the specific weight of the new species of Hydrogen is 7.47 times that of conventional Hydrogen. Note that the specific weight of 15.06 a.m.u. was reached by passing the feedstock gas several times through the zeolite. As a result, the specific weight of 14.06 a.m.u. is not expected for an industrial production of the species based on only one passage.

SPECTRALAB

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Component	Gas
Hydrogen	99.2
Carbon monoxide	None detected
Carbon dioxide	None detected
Methane	0.78
Ethane	None detected
Ethene (ethylene)	None detected
Ethyne (acetylene)	None detected

FIGURE 2: A reproduction of the main results of the signed statement on the chemical analysis of the same sample of Hydrogen used for the test of Figure 1 released by SpectraLab of Largo, Florida, via the use of FTIRS and other detectors showing that the species is composed of 99.2% Hydrogen. Note also the detection of 0.78% methane that, however, is an unconfirmed "experimental belief" because: methane cannot pass through the 0.5 nm zeolite used for the tests; methane is not confirmed at all (let alone in the macroscopic 0.78%) by the GC-MS tests of Figure 3 due to the absence of any appreciable peak in the neighborhood of 16 a.m.u.; and methane cannot be present in the original feedstock gas since the latter is produced at about 10,000° F of the electric arc.

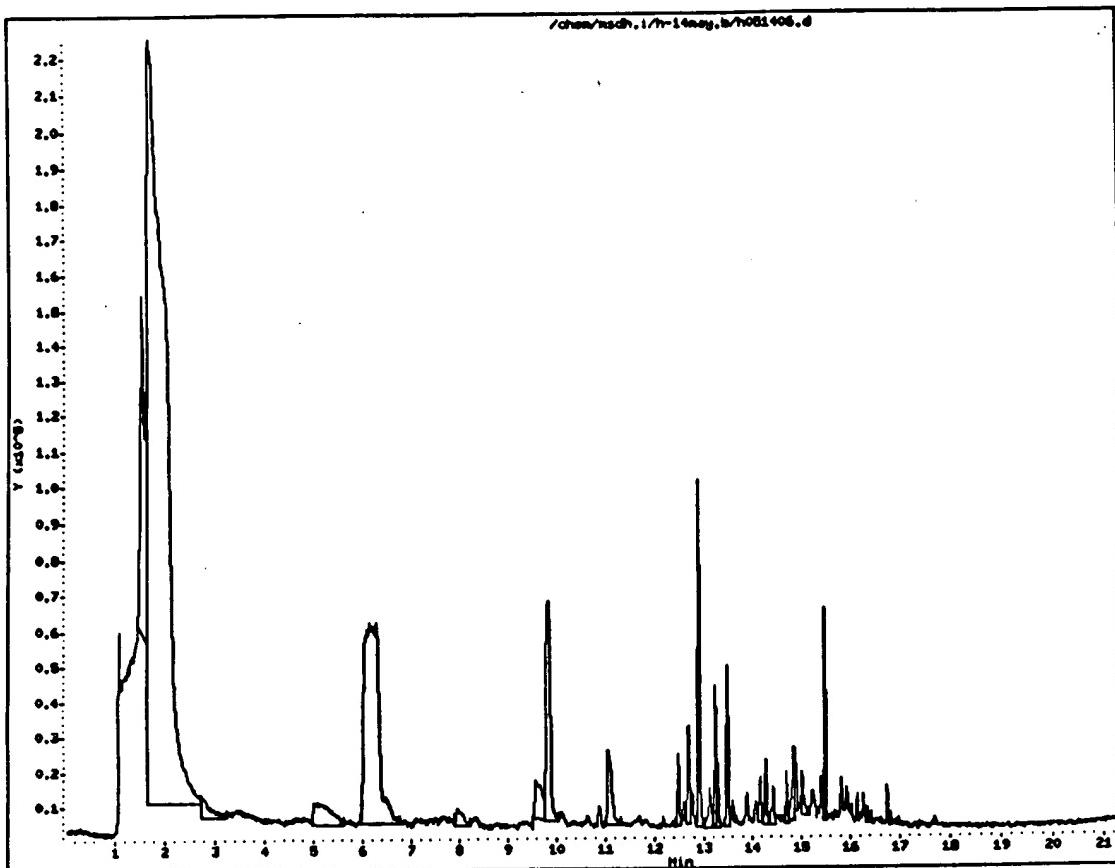
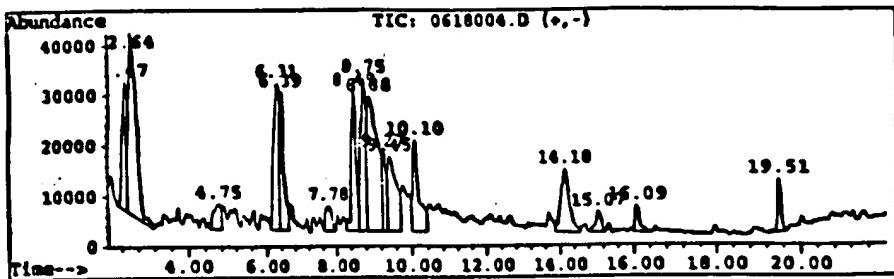


FIGURE 3: One of the several GC-MS scans done by Air Toxic Laboratories in Folsom, California, on the same new species of Hydrogen tested by Adsorption Research Laboratory for specific weight and SpectraLab for chemical composition. Besides the large expected peak at 2 a.m.u. representing H₂, note the numerous additional peaks in macroscopic percentage at 3, 5, 6, 9, 10, 11, 12, etc., a.m.u. Note the absence of any appreciable peak at 16 a.m.u. as needed to represent the methane detected by the FTIRS of the measurements of Figure 2.



Retention Time	Area	Area %	Ratio %
Total Ion Chromatogram			
2.474	1753306	5.386	32.726
2.644	5091514	15.641	95.030
4.754	641520	1.971	11.974
6.307	2737749	0.411	51.098
6.390	2211250	6.793	41.272
7.782	592472	1.820	11.058
8.490	2357396	7.242	43.999
8.754	2784829	0.555	51.977
8.882	5357812	16.460	100.000
9.265	1123809	3.452	20.975
9.448	2421234	7.410	45.191
10.098	1946292	5.979	36.326
14.177	2129791	6.543	39.751
15.073	435208	1.337	8.123
16.085	389822	1.198	7.276
19.509	577433	1.774	10.777

FIGURE 4: A reproduction of the first detection of the new chemical species of Santilli magnecules reported in Ref. [1] done at the National Technical System laboratory located at McClellan Air Force Base in North Island, near Sacramento, California, on June 19, 1998, by analysts Louis A. Dee and Norman Wade who operated a GC-MS equipped with IRD (HP GC model 5890, an HP MS model 5972, and an HP IRD model 5965). The species consists of a gas produced via a DC electric arc submerged in ordinary water. As such, quantum chemists predicts that the heaviest expected element was CO_2 at 44 a.m.u. To avoid the very large peaks for H_2 and CO , the mass range was restricted from 40 a.m.u. to 500 a.m.u. As one can see, the species showed no clearly identifiable and isolated peak at 44 a.m.u., with the presence instead of numerous peaks in macroscopic percentage all the way to 500 a.m.u. None of these peaks could be identified by the computer among all known molecules existing in the memory banks of the McClellan Air Force Base (see [1] for details). Note that the lack of identification with known molecules is not sufficient, per se, to claim the detection of a new non-valence chemical species due to the need of separate confirmations by other instruments.

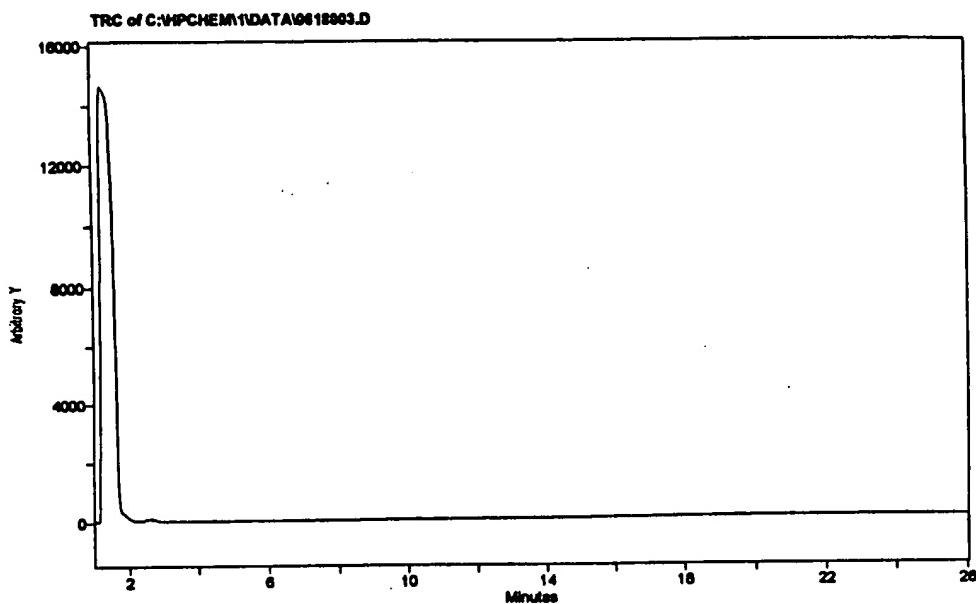


FIGURE 5: The IRD scan of the same spectrum of Figure 4 done by analysts Louis A. Dee and Norman Wade [1] showing that none of the MS peaks have an IR signature at their atomic weight. This complementary test proved that the attractive bond originating the new peaks cannot be of valence type since the cluster size prevents perfect spherical symmetry. Upon a number of repetitions of the tests, the analysts released a signed statement that the species was new. Note the detection of the IR signature of the CO₂ that, however, is a constituent of all the MS peaks, since the CO₂ is not identifiable as an isolated species in the MS scans. Other scans for different mass ranges reported in Ref. [1] have confirmed the additional presence in the peaks of Figure 4 of isolated H, C and O atoms, as well as of radicals O-H and C-H and ordinary molecules, thus confirming the definition of a magnecule reviewed in the tex.

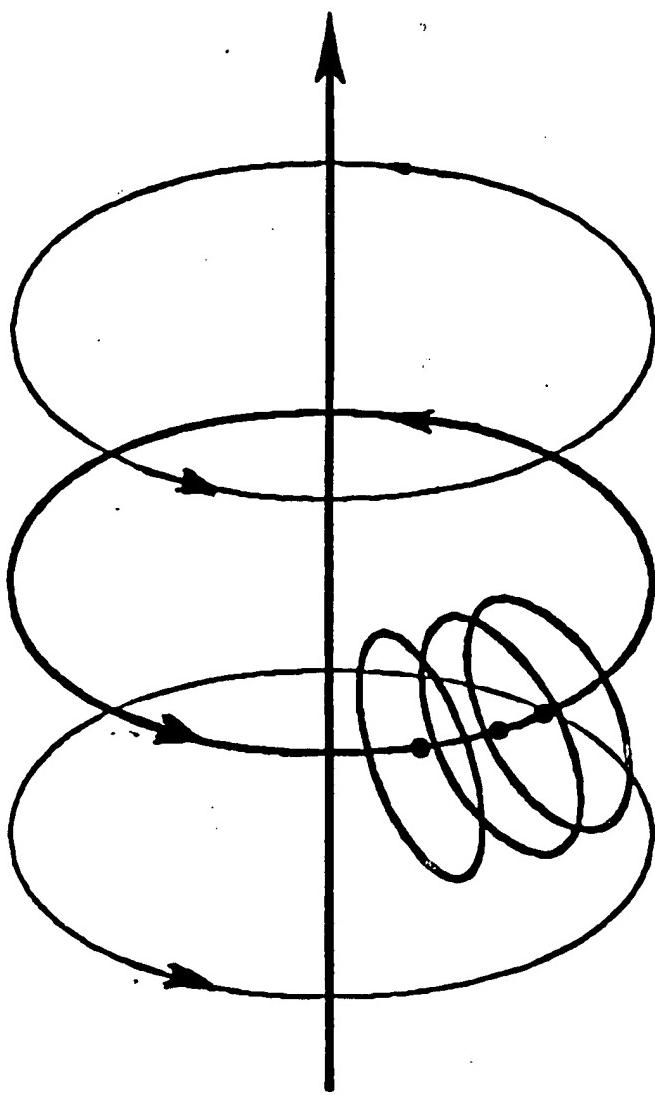


FIGURE 6: A schematic view of the creation of the new species of Santilli magnecules reproduced from Ref. [1]. A DC electric arc with about 3,000 A (represented with the vertical axis) creates a magnetic field (represented with circles perpendicular to the arc) that at atomic distances can reach values of up to 10^{11} Gauss, thus being suitable to polarize atomic orbitals into toroidal distributions (represented with circles perpendicular to the magnetic flux line). The electric arc also aligns polarized atoms one next to the other with opposite magnetic polarities North-South-North-South-etc., thus causing magnetic bonds. Individual toroidal polarizations are unstable. However, bonded polarizations of two or more atoms are stable at ambient pressure and temperature because rotations and oscillations occur for bonded polarized atoms as a whole.

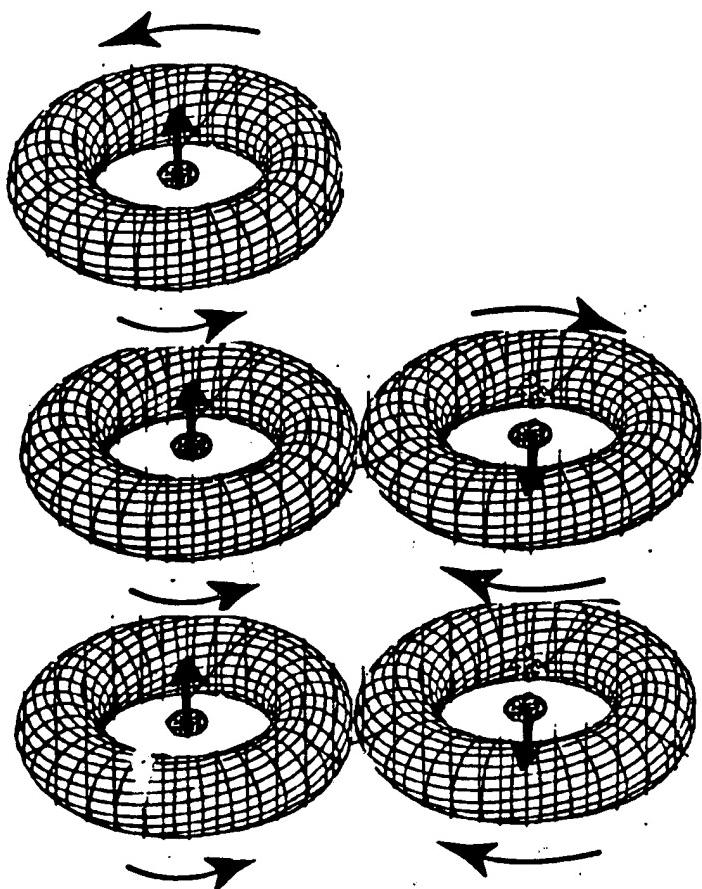
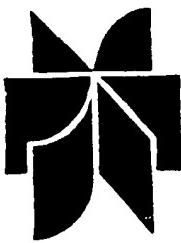


FIGURE 7: A schematic view from Ref., [1] of a magnecule composed of one single polarized H atom bonded to another polarized atom of a C-H radical that, in turn, is magnetically bonded to one atom of an H_2 molecule. The structure has the same atomic weight of CH_4 and, therefore, it appears as methane under FTIR and other detectors resulting in an "experimental belief" due to the lack of an independent verification. The test of the same peak with the IRD reveals the lack of a valence bond at 16 a.m.u. Note that the total magnetic moment of the Hydrogen molecule is depicted in this figure as being null in conformity with its diamagnetic character (because consisting of two opposite magnetic polarities at a very short mutual distance), while admitting magnecular bonds at the level of the individual atoms (see Ref. [1] for details on the model of the H_2 molecule having opposing magnetic polarizations).



INDEPENDENT REVIEWS
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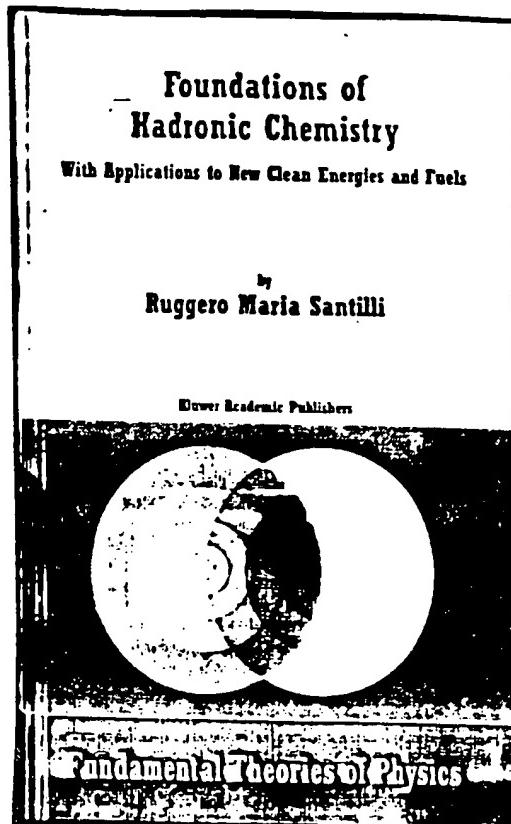
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REVIEWS OF THE MONOGRAPH

R. M. Santilli,
*Foundations of Hadronic Chemistry
with Applications to New Clean
Energies and Fuels*

Kluwer Academic Publishers
Boston-Dordrecht-London
ISBN 1-4020-0087-1
October 2001
EUR 150.00/USD 138.00/GBP 95.00



Review by
Prof. Carl O. Trindle
Department of Chemistry, University of Virginia, U. S. A.

Adventurous readers who are ready for a fresh view of electrons in atoms will find this work baffling, enraging and stimulating in the extreme. This has always been the reaction to physics' heroic decision to leave everyday intuition behind, when facing the world of the very small. Here is an opportunity to test your understanding of the mechanics of electrons in molecules, in the face of a radically different reimagining of the physics.

Review by
Dr. Arthur Thomas
National Analytic Laboratories, U.S.A.

I was first shocked to discover the limitations of current analytic equipment I had used for all my laboratory life, such as gas or liquid chromatographers, infrared or ultraviolet detectors, etc. I was then thrilled to the extreme by the vast experimental evidence of the new chemical species of Santilli magnecules which, undoubtedly, will imply a revision of our current knowledge of all atomic bonds, including valence bonds, liquid structure, polymers, etc. The importance of the monograph can be pointed out by nothing that, thanks to his new hadronic chemistry, Prof. Santilli has discovered the only, basically new chemical species since the discovery of molecules in the 1800s.

Review by
A. O. Animalu
University of Nigeria, Nsukka

"The novel "hadronic chemistry" created by Prof. Santilli is a historical discovery whose validity is established by its achievement, for the first time in the history of chemistry, of essentially exact representations of molecular characteristics, including binding energies, electric and magnetic dipole moments, while conventional quantum chemistry still misses a few percentages of the binding energy, with larger percentages missing for the electric and magnetic dipoles which are at time wrong even in the sign (as it is the case for the water molecule). These achievements are based on a new notion of valence bond characterized by a strongly attractive force between valence electron pairs in singlet coupling (as dictated by Pauli's principle). This new electron bond was first derived by Prof. Santilli and myself for the structure of a Cooper pair in superconductivity. The new valence bond originates from nonlinear, nonlocal and nonpotential interactions of contact type due to deep overlappings of the wavepackets of valence electrons. In turn, these interactions are simply beyond the descriptive capacity of the mathematics of quantum mechanics and chemistry, let alone their physical and chemical laws. The representation of these nonhamiltonian forces requested Prof. Santilli to work out first a structural generalization of the mathematics underlying quantum mechanics and chemistry and only thereafter construct a structural generalization of these disciplines. The net result is a scientific edifice whose novelty, dimension and diversification appears to be unprecedented in the history of science.

Review by
Prof. J. V. Kadeisvili
Institute for Basic Research, U.S.A.

Prof. Santilli has repeatedly stated that "*There cannot be really new advancements in science without really new mathematics, and there cannot be really new mathematics without new numbers.*" This monograph is, perhaps, the most vivid illustration of the depth of such thinking. In fact, ALL discoveries and achievements by Prof. Santilli in this monograph are basically dependent on a new mathematics which, in turn, is centered in new numbers, Santilli iso-, geno- and hyper-numbers. There is little doubt that Prof. Santilli's advancements signal a new era in chemistry with novel applications very important for society, such as new clean fuels and energies, whose existence is prohibited by the old chemistry.

Review by
Prof. A.K. Aringazin
Eurasian National University, Kazakhstan

The monograph by Prof. R.M. Santilli presents the construction and application of hadronic mechanics to basic chemical problems. The main theoretical focus of the book is that both quantum mechanics and chemistry can be rigorously extended to their hadronic counterparts, opening a possibility of incorporating nonunitary interactions in a mathematically beautiful formalism, and to predict and explore strikingly new physical and chemical phenomena. The electrons correlation issue receives a new look by including nonpotential interactions between the electrons in microscopic systems. Of fundamental and industrial importance is the insight given into the puzzling problem of new chemical species of magnecules discovered by Prof. Santilli, and the way how they are produced and utilized to synthesize new clean fuels. The reader will find an excellent introduction to this vibrating new field of research from the first hand.

Review by
Prof. Jeremy Dunning Davies
University of Hull, England
in press at
Foundations of Physics

Despite known historical achievements, after one century of research quantum chemistry has left a number of unresolved basic issues, among which we recall: 1) the lack of exact representation of molecular data when derived from first axiomatic principles, with deviations of the theory from experimental data on binding energies of the order of 2%, and bigger deviations for electric and magnetic moments which are at time wrong even in their sign; 2) the inability to permit accurate thermochemical calculations since 2% is missing in the representation of binding energies correspond to about fifty times the typical energy releases of thermochemical reactions such as that in the formation of the water molecule; 3) the absence of an attractive valence force sufficiently strong to explain the strength of molecular bonds actually existing in nature, since the total electric and magnetic forces between atoms of diatomic and other molecules can be proved to be null, while the remaining van der Waal, exchange and other forces are insufficient for an attractive force of the needed strength; 4) the inability to restrict valence bonds to electron pairs only, thus essentially implying the prediction of hydrogen, water and other molecules with an arbitrary number of constituents; 5) the prediction that all molecules are paramagnetic, which is a consequence of the lack of restriction of valence bonds to electron pairs only, in which case all atoms of a molecule can acquire the same magnetic polarization (thus implying that all molecules are paramagnetic) when exposed to an external magnetic field, which prediction is in dramatic disagreement with experimental evidence; and other unresolved basic problems.

In this pioneering monograph, the Italian-American physicist Ruggero Maria Santilli has submitted a structural generalization-covering of quantum mechanics and chemistry under the name of 'hadronic mechanics and chemistry' which appears to resolve the above problematic aspects. In fact, the new mechanics achieves essentially exact representations of molecular characteristics; consequently permits exact thermochemical calculations; introduces a new, strongly attractive force between valence pairs in singlet coupling with the strength needed to represent reality; restricts valence bonds solely to electron pairs in singlet couplings; eliminates the prediction of an arbitrary number of atomic constituents in molecular structures; and correctly represents the diamagnetic or paramagnetic character of the various molecules.

The above achievement originates from the assumption that valence forces are nonlinear (in the wavefunction), nonlocal-integral (over a volume), and of contact-nonpotential type due to the deep overlapping of the wavepackets of valence electrons in singlet coupling. In turn, this novel 'Santilli valence force' is dramatically beyond any possibility of quantitative representation via quantum mechanics and chemistry, since the latter are notoriously linear, local and potential.

The covering of quantum mechanics and chemistry for the invariant representation of the indicated new valence forces is based on a new mathematics, today known as 'Santilli isomathematics', which is based on real-valued (Hermitean) and nowhere singular, yet arbitrary integro-differential units at all levels of the theory, from numbers to Schroedinger's equations. Being by central assumption beyond any representational capability via a Hamiltonian, Santilli's new valence forces are represented with the generalized integro-differential units. In turn, the representation of the new valence forces with a unit assures the invariance of the theory (that is, the prediction of the same numerical values at all times under the same conditions), since the unit is known to be the basic invariant of all theories.

Santilli also provides simple means for the construction of hadronic mechanics and chemistry at all levels, which means are given by nonunitary transforms of all aspects of conventional theories. Such a nonunitary character also ensures that hadronic mechanics and chemistry are outside the class of equivalence of conventional theories. Intriguingly, hadronic mechanics and chemistry result in an explicit and concrete realization of the theory of hidden variables, as well as a completion of quantum mechanics and chemistry much along the lines of the celebrated argument by Einstein, Podolsky and Rosen of 1935. Also intriguingly, isotopic operator theories admit a generalization of Bell's inequality which possesses a classical counterpart, with consequential profound revisions of local realism and all that.

Particularly important for all researchers in generalized theories is the review of catastrophic inconsistencies of all noncanonical-nonunitary theories formulated via conventional mathematics, which include: lack of invariance in time of basic units with consequential lack of applicability of the theory to measurements; lack of numerical values invariant in time; lack of preservation of thermicity, with consequential absence of observables, violation of causality and probability laws, violation of the basic axioms of special relativity; and others. Santilli has constructed his

isomathematics precisely for the purpose of resolving these inconsistencies and achieving invariant, axiomatically correct nonunitary methods. The study of the resolution of the above catastrophic inconsistencies should, therefore, be instructive to all scientists.

The above new methods are specifically intended in the monograph for the study of molecular structures conceived as reversible systems isolated from the rest of the universe with Hamiltonian and nonhamiltonian internal effects, and are presented as part of the isotopic branch of quantum mechanics and chemistry.

In addition to the above achievements, Santilli presents in this monograph the first known invariant formulation of irreversibility at all levels, from classical to operator systems. The starting point is the historical legacy of Lagrange and Hamilton of representing irreversibility with the external terms in their celebrated equations, which terms have been removed from analytic equations throughout virtually all of the 20-th century. For certain reasons of consistency, Santilli reformulates identically the true analytic equations (those with external terms) in a form admitting a Lie-Admissible structure in the sense of the American mathematician A. A. Albert. The formulation is then extended from the classical to all subsequent levels of treatment, including quantization and operator formulations. In this way, irreversibility emerges as originating from the most elementary levels of nature, such as protons and electrons in the core of a star (rather than when moving in vacuum as in the structure of the hydrogen atom which is reversible). Therefore, Santilli resolves the known impossibility of reducing a macroscopic irreversible classical system into a finite collection of elementary particles all in reversible conditions, an inconsistency which follows from the assumption of the exact validity of quantum mechanics, not only for reversible systems such as atoms, but also for particles in interior conditions.

It should be indicated that Santilli's formulation of irreversibility is based on an additional, basically new mathematics, today known as 'Santilli genomathematics', which is characterized by two real-valued nonsingular, yet nonsymmetric, generalized units interconnected by Hermitean conjugations, one of which is assumed to characterize motion forward in time and the other motion backward in time. The differences between the basic units for the two directions of time then guarantee irreversibility for all possible reversible Hamiltonians. By recalling that all known potential interactions are strictly reversible, these nonsymmetric generalized units (known as 'Santilli genounits') represent the interactions responsible for irreversibility, namely, Lagrange's and Hamilton's external terms.

These second methods are specifically intended in the monograph for an invariant representation of open irreversible processes, such as chemical reactions, and are presented has part of the 'genotopic' branch of hadronic mechanics and chemistry'.

The monograph continues with the presentation of yet a third generalization-covering of quantum mechanics and chemistry based on a yet more general new mathematics, today known under the name of 'Santilli hypermathematics', which is characterized by 'multi-valued', real-valued, nonsingular and nonsymmetric generalized units at all levels of study, from numbers to Schroedinger's equations. The need for this further generalization of the preceding already broad methods is proved by showing that biological structures cannot be consistently represented via genotopic formulations because, although the latter ensure the invariant treatment of the irreversibility of biological systems, their single-valuedness implies inconsistencies, such as the lack of a quantitative representation of the growth in time of sea shells.

These third methods are presented in the monograph as being specifically conceived for biological systems, although they apply equally to other branches of science (such as cosmology) and are indicated as being part of the hyperstructural branch of hadronic mechanics and chemistry.

Thanks to these powerful new methods, Santilli presents, in Chapter 8 of the monograph, a basically new chemical species, today known as Santilli's magnecules, in which atoms are bonded together into stable clusters by new internal attractive forces due to the magnetic and electric polarization of the orbitals of individual atoms (rather than molecules). A rather impressive array of experimental evidence supporting the new species of magnecules is also presented.

Finally, and quite remarkably after all the preceding achievements, Santilli presents the application of the new methods and the chemical species of magnecules to the industrial production of a new fuel he calls MagneGasTM (see www.magnegas.com), whose combustion exhaust is so clean that the new fuel has been certified not to require catalytic converters.

In a nutshell, the monograph lends credence the view expressed repeatedly by Santilli in earlier work, that 'there cannot be really new scientific theories without really new mathematics, and there cannot be really new mathematics without new numbers'.

Hadronic mechanics was proposed by Santilli in 1978 jointly with its basic Lie-admissible structure when he was at Harvard University under DOE support, and its study was continued by mathematicians, theoreticians and experimentalists too numerous to quote here (see the bibliography of the monograph), although Santilli remains to this day the most active contributor in the field.

Among a vast authorship in hadronic mechanics encompassing over 1,000 papers, 18 monographs and 50 volumes of conference proceedings, we should indicate that mathematical maturity was reached only in 1996 in a special issue of the *Rendiconti Circolo Matematico Palermo, Suppl. Vol.*

42, under the editorship of P Vetro; physical maturity was reached subsequently by Santilli as published in *Foundations of Physics* Vol. 27, pages 625 and 1159, 1997 (invariance of isotopic and genotopic nonunitary theories, respectively) and *Foundations of Phys. Letters* Vol. 10, p. 307, 1997 (Iso-Grand-Unification); geometric maturity was reached by Santilli in *Intern. J. Modern Phys. D* Vol. 7, age 351, 1998 (formulation of gravity via generalized units; invariant geometric unification of the Minkowskian and Riemannian geometries; consequential unification of special and general relativities; formulation of gravity which is invariant under the Poincare - Santilli isosymmetry).

Among the main contributors to the novel hadronic chemistry we note: the physicist A. O. E. Animalu for his co-work with Santilli on a model of the Cooper pair and its excellent experimental verifications (this Animalu-Santilli model set the foundations of the new model of valence bond); the chemist D. D. S. Shillady for his co-work with Santilli on the construction of the new molecular models (today known as Santilli-Shillady isochemical molecular models) and the proof that they provide a representation of molecular characteristics exact to the desired digit; and the physicist A. K. Aringazin and his coworkers for various crucial verifications of the validity of the new chemistry, as well as of the new chemical species, of Santilli magnecules. There is little doubt that numerous additional independent contributions in these new scientific frontiers can be expected.

Review by
Prof. Erik Trell
Linkoping University, Sweden
in press at
International Journal of Hydrogen Energy

Everything has a history - or two. When reviewing a pioneering treatise like the Italian-American physicist Ruggero Maria Santilli's ground-breaking monograph, "Foundations of Hadronic Chemistry. With 'Applications to New Clean Energies and Fuels'" some epistemological reflections would seem to be extra warranted because of its virtual backwards-to-the-future renaissance of Physics, Chemistry and Mathematics as equivalent powers in the synopsis. A serious scientific dilemma nowadays is otherwise that the latter discipline has seized supreme command and that, as stated by William M. Honig, the ruling mathematical doctrine "since the 1920s? has had a stultifying effect on developments in physics".

This is not how it used to be, when Nature directed. It is of course a primordial conception that Existence springs from a synthesis of opposites/adjacents, like in the Nordic Mythology, where life whirls in the thin tempered interstice (*Ginnungagap*) between the outer, rectilinear, openly infinite deep-frozen darkness of *Nilfeheim*, and the inner, blazing, lighting-fast rotating, closedly infinite fire-ball of *Maspellsheim*. Even earlier, for instance, as expressed by the Yin-Yang symbol, a similar process was apprehended in the Orient of a spiralling transition between the complementary endless forms of Straight contracting into Round, the immense collective difference of which at the Cosmic level after long-winded journey (it is tempting to infer) disperses everywhere over the surface of the perfect sphere as the last decimal of π . In consequence, and with pronounced bearing to the mathematics which Professor Santilli has disclosed, there is inherent motion in this projection because the realization comprises its own automatically congruent infinitesimal operator, or iso-unit.

And analogously applies to the ancient Greek - but vice versa. They "are famous for a completely brilliant idea, namely, to use spatial images to represent numbers", where, however,

"Euclid's Mathematics was closely associated with his concept of the world, which in accordance with Aristotle was that the Universe is enclosed in a sphere, in the interior of which space and the bodies full-fill the properties of Euclidean Geometry".³ So, in the Occident, Mathematics came to assume a perspective falling from the vaulted firmament to the straight line and ultimately the vanishing intersection point as irreducible reference and elements. This orthogonal architecture of Western Mathematics where the static terms don't supply any kinetics (but a transcendental First Cause provided primum movens) persisted also after the Arabs replaced implicit figures and explicit constructions with algebraic letters and arithmetics, as can be seen, e.g. in the epoch-making doctoral thesis of Marius Sophus Lie, *Over en classe geometriske transformationer*⁴, from the English translation of which the following is quoted:

"The Cartesian geometry, namely, translates any geometric theorem into an algebraic one and thus of the geometry of the plane renders a faithful representation of the algebra of two variables and likewise of the geometry of space a representation of the algebra of three variable quantities"? "the geometrical transformation that is founded upon the Poncelet-Gergonne reciprocity can be perceived as consisting of a transition from a point to a straight line as element"? "The in the following presented new theories are founded upon the fact that one can choose any space-curve which depends upon three parameters as the element of the space"? "each point in space?is associated with a cone, namely, the collection of tangents?that go through the point in question"? "A partial differential equation of the first order between x,y,z is?equivalent to?finding the general surface which in each of its points touches a cone associated with the point in question?"

Now, Lie revolutionized the mathematical comprise and compass by expanding these operations back to spherical and related geometries and clarifying the sets of continuous transformation groups deployable in and between them. But the inherited defect persists in the cores of the functions, that their constituent lines and points are left without. When Nanotechnology at all fronts is now approaching the genuine footing of tangible reality, it discontinuously halts at the very threshold where the elementary particles substantially enter: what are they, and how are they? It is comparatively more and more surrealistic to accept them as primarily mechanical points/packets/waves rigidly oscillating/amorphously radiating in and from disparate ready-made quantum cavities as they were provisionally once depicted 50 to 100 years ago and more, however accurate the calculations of their external affairs. It is true, that spectroscopical observations soon necessitated inside arrangements but (the neighborhood versions of) the established algorithms governed there, too, to quark and their orbits, partial charges and masses, fluxing gluons and so on.

The resulting inconsistencies are large and profound and actually the pragmatic impulse and reason; the effective white spot for Professor Santilli's altogether regular exploration, in this case of the chemical aspect of the panorama. And here I think we need to ask also ourselves as readers: are we yet true scientists, open-minded, bold, curious as our vocation prescribes? Do we still delight in breaking new grounds - and taboos, above all those founded on superstition or prejudice or routine? Refreshed blood, moreover, is getting a survival condition for scholarly Science, left astern by industrial and military research in a situation when bright young Chemistry as well as Physics graduates rather seek their fortune there or on Wall Street than join the increasingly ecclesiastical promotion ladders at dogmatically inveterate Academia. Indeed, given sufficient talent, there is nothing to stop the endeavour that Professor Santilli has undertaken. On the contrary, the facultative merit of his findings is that they are not only compatible with but contributing to Quantum Chemistry and Mechanics, filling vital gaps that just lie beyond the definitions of these at a domain where they simply don't comply.

Professor Santilli initially identifies some of the major Quantum Chemistry shortcomings which can be resolved by his structural generalization-covering under the name of "Hadronic Mechanics and Chemistry":

- 1) lack of exact representation of molecular data (on binding energies of the order of 2%, and bigger deviations for electric and magnetic moments which are at time wrong even in their sign);
- 2) inability to permit accurate thermochemical calculations;
- 3) the absence of an attractive valence force sufficiently strong to explain the strength of molecular bonds actually existing;
- 4) the inability to restrict valence bonds to electrons pairs only;
- 5) the prediction that all molecules are paramagnetic; and others

This accomplishment originates from the deduction that, unlike in local, linear and potential Quantum Mechanics and Chemistry, the novel "Santilli valence force" is nonlinear (in the wavefunction), nonlocal-integral (over a volume), and of contact-nonpotential type due to the deep overlapping of the wavepackets of valence electrons in singlet coupling. It is based on a new Mathematics, today known as "Santilli Isomathematics", with invariant real-valued, nowhere singular, yet arbitrary integro-differential units at all levels, from numbers to Schroedinger equations. The representation thus assures the invariance of the theory.

In short, he sets dynamics into realization by isotopic operators not only enabling running transforms of conventional theories but also exposition of hidden variables, a generalization of Bell's inequality and a completion of Quantum Mechanics and Chemistry much along the celebrated argument by Einstein, Podolsky and Rosen of 1935. The "catastrophic inconsistencies of conventional Mathematics" in these and other respects are reviewed, including lack of invariance in time of basic units and numerical values with consequential lack of applicability to measurements, absence of preservation of Hermiticity with consequential absence of observables, violation of causality and probability laws as well as the basic axioms of Special Relativity. The elimination of such defects by Santilli's Isomathematics should be most instructive reading for all true scientists. The new methods are specifically described for the study of molecular structures conceived as reversible systems isolated from the rest of the universe with Hamiltonian and non-Hamiltonian internal effects, and are presented as part of the "isotopic branch of Quantum Mechanics and Chemistry."

In addition, the first known invariant formulation of irreversibility at any level, from classical to operator systems is presented, founded upon Lagrange's and Hamilton's legacy of representing irreversibility by the re-introduction of those external terms in their celebrated equations which have otherwise been removed from the analysis throughout virtually the entire 20th century. By stating the retrieved "true analytic equations" in a corresponding form, Professor Santilli establishes a Lie-admissible structure in the sense of the American mathematician A. A. Albert. This is then extended from the classical to all subsequent levels of treatment, including quantization and operator formulations. In this way irreversibility emerges as originating from the most elementary levels of nature (such as protons and electrons in the core of a star), thereby demonstrating the known impossibility of reducing a macroscopic irreversible classical system into a finite collection of elementary particles, each of which like in Quantum Mechanics postulated to be in reversible condition.

Here an additional new mathematics enters the exposition, today known as "Santilli Genomathematics" and characterized by two real-valued and nonsingular, yet nonsymmetric, generalized dynamic units interconnected by Hermitean conjugations, one of which is designated to motion forward in time and the other to motion backward in time. The differences of these basic units then guarantees irreversibility for all else reversible Hamiltonians. By recalling that all known potential interactions are strictly reversible, these nonsymmetric generalized units (known as "Santilli genounits") represent the interactions responsible for irreversibility, namely, Lagrange's and Hamilton's external terms, and are especially exemplified in the monograph as part of the "genotopic branch of Hadronic Mechanics and Chemistry" for an invariant representation of open irreversible processes, such as chemical reactions.

The book continues with an account of a third extended generalization-covering Quantum Mechanics and Chemistry based on an even more general new Mathematics, today known under the name of "Santilli Hypermathematics," which is characterized by "multi-valued", real, non-singular and non-symmetric generalized units at all levels of study. The need for the further generalization is shown by the concrete example of growth in time of sea shells where the single-valuedness of genotopic formulations don't assure the invariant treatment of the irreversibility of biological systems. This third method is hence presented in the monograph as being specifically applicable to these (but also to other branches of Science, e.g. Cosmology).

The powerful theories get equally strong confirmation and harvest by the exciting discovery and extraction of a new, remarkably corresponding chemical species named "Magneolecules," in which atoms are bonded together into stable clusters by internal attractive forces due to the magnetic and electric polarization of their orbitals. Impressive experimental data supporting the existence and properties of Santilli's Magneolecules are given.

Finally, and crowning the preceding ground achievements, Santilli describes the application of the new methods and the chemical species of Magneolecules to the industrial production of a new fuel he calls "MagneGas"?, and whose combustion exhaust is so clean that it

has been certified not to require catalytic converters.

The monograph proves the viewpoint repeatedly expressed by Santilli in his works, that there cannot be really new scientific theories without really new Mathematics, and there cannot be really new Mathematics without new, and active, numbers. However, there is a mutual objective study and analysis of rendered Nature, which remains the firm and unquestionable basis and where therefore in their proper generating, assisting and interpretative powers, "the newer concepts in mathematics" are neither the "servants" nor the "masters" but the equals. Seeing that a formula does the job spurs considerations on the phenomenon exhibiting such behavior. But it is the patient and reflective observations and explorations of Reality that conducts the designated mind to the appropriate Mathematics. That Professor Santilli, repeatedly nominated for the Nobel Prize, is extremely well equipped and capable to both ends is amply documented, first and foremost by his work, but also by the biographic and bibliographic sections of the monograph which deserve to be briefly summarized as well.

He proposed Hadronic Mechanics already in 1978 jointly with its basic Lie-admissible structure when he was at Harvard University under US Department of Energy support. Its study was continued by mathematicians, theoreticians and experimentalists too numerous to quote here (but included in the book's references). However, Santilli remains to this day the most active contributor, eventually bringing the venture to full mathematical maturity in 1996, physical maturity in 1997 and geometric maturity in 1998. Among the main contributors to the novel Hadronic Chemistry also the Physicists A. O. E. Animalu (co-work and verification on Cooper pair model!) and A. K. Aringazin et al. (validation of the new Magnecule species and Chemistry), and the chemist D. D. Shillady (co-work on new molecular model) are prominent. No doubt many more will follow when rich, solid, convincing evidence and revenues are now accumulating, of the greatest importance for Mankind in evermore desperate need of clean energies - and enhanced understanding of the world.

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